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SPECIAL REPORT

PAYING THE BILL: MANUFACTURING AND AMERICA'S TRADE DEFICIT

CONGRESS OF THE UNITED STATES OFFICE OF TECHNOLOGY ASSESSMENT

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Foreword

In the 1980s, the United States has experienced large current account deficits, particularly in manufactures trade. This special report analyzes the causes of the deterioration in America's trade performance and examines the importance of U.S. manufacturing in helping the nation improve its position in international trade. The report was requested by Senator John Heinz as part of an assessment of technology, innovation and U.S. trade requested by the Senate Committee on Finance; the Senate Committee on Banking, Housing and Urban Affairs; and the House Committee on Banking, Finance and Urban Affairs. A final report will be published in 1989.

In recent years, the Federal budget deficit, the overvalued dollar, and high real interest rates have helped to boost domestic consumption and increase imports. Some countries have concentrated on exporting to the U.S. market, while keeping their own markets relatively closed. Another very important factor is that the United States has lost its once substantial edge in manufacturing technology. Reversing these trends will not be easy.

The relative decline of U.S. manufacturing is worrisome. Although services trade and employment is growing, manufacturing remains vitally important to the U.S. economy. Manufactured goods continue to dominate in international trade, many service industries depend heavily on manufacturing, and manufacturing remains an important source of well-paid jobs. The United States has to improve its manufacturing performance if it is to maintain its economic strength.

A weaker dollar has helped to increase exports of U.S. manufactures in the first quarter of 1988, but counting on the lower dollar alone to sell American manufactured goods is a shaky strategy with risks of painful adjustments. Changes in fiscal and trade policies will be needed. Additionally, improved manufacturing competitiveness – the ability to make high-quality goods at reasonable costs, without sacrificing our standard of living to get costs down – will be crucial for the United States to eliminate the trade deficit.

OTA thanks the panel members, reviewers and other individuals in government, business, labor, and academia who provided data and advice. As with all OTA reports, the responsibility for content is OTA's alone.

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U.S. Department of Labor
Bureau of Labor Statistics

Contents

List of Tables

List of Figures

Summary

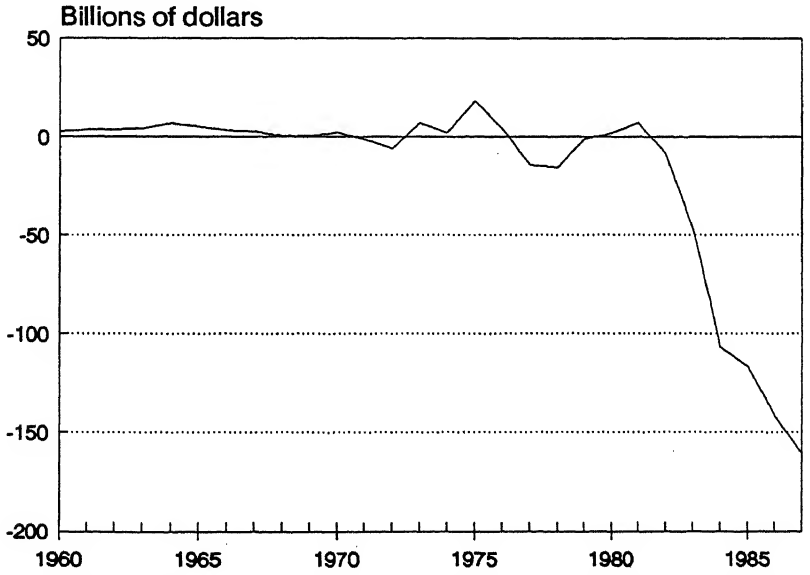
In the 1980s, the United States lived beyond its means to an extent unimaginable a few years before. Consumption rose—both in absolute terms and as a percentage of GNP—with consumption of foreign-made goods leading the way. Imports grew at an average rate of 8 percent per year between 1980 and 1987, far outpacing exports. Investment recovered soon after the 1982 recession. Federal government spending surged ahead of reduced tax revenues, causing the biggest peacetime budget deficits in U.S. history. And in the process, the United States, a creditor nation since World War I, quickly became the world's leading debtor. Its net indebtedness exceeded $400 billion in 1987, and could reach $1 trillion by the early 1990s.

The U.S. current account balance—the most comprehensive measure of trade in goods and services—was stable throughout the 1950s and 60s and experienced some tremors in the 1970s. Then, beginning in 1981, it nosedived (figure1). The only way the United States was able to sustain this deficit was with loans and investments from abroad. A massive infusion of foreign capital allowed Americans to live beyond their means. It cannot continue, though, and therein lies the problem.

No nation, not even one as rich as the United States, can go on forever paying its current account deficit with foreign capital. A time of reckoning will come. As the United States sinks deeper into debt, foreign investors and creditors—central banks, individuals and firms—will be less inclined to commit ever-increasing amounts of capital to a $4 trillion economy on a spending spree.

The trade deficit will go away. As the flood of foreign capital ebbs, the United States will be forced to rein in government spending, business investment, or consumption—or all

Figure 1.
U.S. Current Account Balance
1960-87



SOURCE: U.S. Department of Commerce, Bureau of Economic Analysis, Business Statistics: 1986. (Washington, DC: U.S. Government Printing Office, 1987) Appendix II, U.S. International Transactions, p. 250; U.S. Department of Commerce, Bureau of Economic Analysis, Survey of Current Business, March, 1988, p. 31, table D.

three. Whether this comes about through slower growth, or through a recession that cuts investment and consumption in absolute terms, will depend on how competitive American manufacturers are and how fast other major economies are growing. One way or another, exports will have to exceed imports. A recession could force this to happen, by cutting consumption and thus restraining imports. So could a further drastic fall in the value of the dollar, raising the price of imported goods beyond the means of many consumers, making video cassette recorders, imported cars, and so on luxury items for the few.

A less painful course is not only to make needed macroeconomic adjustments, but also to get better at manufacturing—to make a wide range of high quality goods at competitive costs. That is the most constructive way to recapture some of our own markets and raise exports. Such gains will not be easy to win, however; they will require concentrated efforts on the part of U.S. producers to improve manufacturing productivity and quality. And they will require redoubled efforts on the part of the U.S. government to promote American manufacturing; for example, through export promotion and through policies that will ease the pressures on manufacturers to pursue short-term profits at the expense of longer term investments in technology and market share.

The Trade Deficit: In What and To Whom?

The U.S. trade deficit is mostly a deficit in the trade of manufactured goods. Of the $161 billion current account deficit in 1987, 85 percent was in manufacturing trade (figure 2). The growing U.S. service sector cannot generate sufficient trade to offset continuing deficits in manufactured goods trade. The services trade is simply not big enough; goods can be stored and shipped while services by and large cannot. Moreover, the surpluses the United States has enjoyed in services trade are shrinking. Other nations have become more competitive in an array of services that are traded internationally—from engineering to banking and software design.

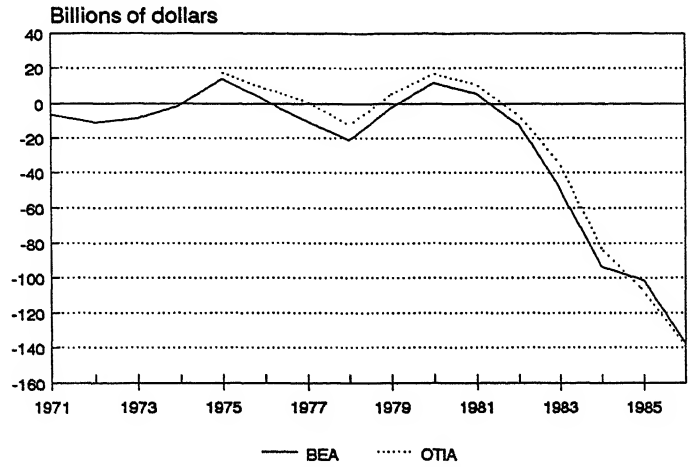
Nearly three-quarters of the U.S. manufacturing trade deficit is in three product areas:

- motor vehicles and parts (a $53 billion deficit);
- textiles, apparel and shoes (a $28 billion deficit);
- electronics, especially semiconductors, telecommunications equipment and consumer electronic items (a $22 billion deficit).

The countries with which the United States runs the largest trade deficits are, in order: Japan, Taiwan, West Germany, Canada, South Korea, Hong Kong, Italy, Mexico, Brazil, and Great Britain (see figure 3).

Japan accounted for 36 percent of the U.S. merchandise trade deficit in 1987—about $57 billion. From Japan came 21 percent ($85 billion) of U.S. merchandise imports, but to Japan went only 11 percent ($28 billion) of U.S. merchandise exports. The leading Japanese import by far was motor vehicles and parts—about 30 percent of all imports from that country. Other major imports from Japan include consumer electronic products, telecommunications equipment, computers and their attachments, other office machinery (e.g., copying machines), and semiconductors.

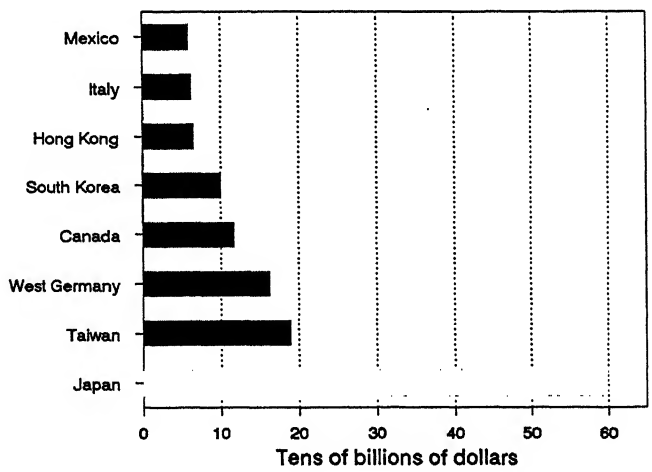
Figure 2.
U.S. Manufacturing Trade Balance 1971-86



NOTE: Bureau of Economic Analysis firgures are merchandise trade less petroleum imports and agriculture exports.

SOURCE: U.S. Department of Commerce, Bureau of Economic Analysis, Survey of Current Business, Table 3, June 1982 and 1987; U.S. Department of Commerce, Office of Trade and Investment Analysis, Presentation by Allen Lenz, "U.S. Trade Deficits and International Competiton."

Figure 3.
Largest U.S. Trade Deficits by Country, 1987



SOURCE: U.S. Department of Commerce, Office of Trade and Investment Analysis, 1988 unpublished data.

The deficit with Japan has accounted for one-third to one-half of the U.S. merchandise trade deficit for the last decade, growing tenfold in that time from $5.5 billion to almost $57 billion. The U.S. merchandise trade deficit with Asian countries other than Japan has also grown significantly over the past decade. By 1987 it had reached $47 billion, of which nearly three-quarters was with Taiwan, South Korea, Hong Kong, and Singapore.

In 1980, the United States had a merchandise trade surplus of $20 billion with Western Europe. By 1987, this surplus had turned into a deficit of $27 billion, with West Germany accounting for more than half ($15 billion). Automotive products are the number one item in the U.S. merchandise trade deficit with Western Europe.

As the U.S. deficit declines, the countries exporting most to the United States will have to adjust to exporting less—or at the least, slowing the growth of exports. Although the adjustment will not be easy for anyone, countries that can expand consumption in their own economies, and that have low unemployment rates, strongly competitive manufacturing industries, and healthy trade surpluses, are best equipped to weather the changes.

Causes of the Trade Deficit

There is no one cause and no single cure.

Macroeconomic policies certainly contributed to the deficit. In the 1980s, the United States has pursued expansionary fiscal policies, while most other industrialized nations acted to restrain their deficits. As a result, the United States needed to borrow money, and real interest rates had to rise to attract it. In response countries such as Japan and West Germany invested their savings in the United States. This, in turn, increased the demand for dollars and pushed up the dollar's value. The strong dollar made goods produced in the United States more expensive for foreigners and foreign goods cheaper for Americans.

But the strong dollar is only part of the story behind the U.S. trade deficit. The dollar peaked in the first quarter of 1985 and since then its value has fallen by one-third relative to other major currencies. It is now at postwar lows against the yen and the German mark. Despite this 3-year decline, and despite the recent upsurge in exports, the U.S. merchandise trade deficit was running at an annual rate of well over $100 billion in 1988. The deficit with Japan hit a new record in 1987, and only began to decline in the first months of 1988. It seems that the devalued dollar spurred U.S. exports, but it did not reduce merchandise imports until April 1988.

There is further evidence that something in addition to currency exchange rates is at work here. U.S. manufacturers of products as diverse as automobiles, integrated circuits and color televisions began to lose their world market share well before the dollar's rise. Moreover, since about 1970, U.S. manufacturers have been able to hold on to their shares of world markets only when the dollar's value is falling, making U.S.-made goods progressively cheaper compared to goods made in other countries. This suggests loss of competitiveness.

Of course, the United States cannot expect to dominate world markets to the extent it did in the first couple of decades after World War II. War-damaged industrial countries recovered, and the diffusion of capital and technical knowledge made it possible for some of the poorer countries to achieve

vigorous economic growth. The world economy became richer—a desirable result, and one which has long been the aim of U.S. policy.

The fact remains that the U.S. market—the largest and richest in the world, and one of the most open to foreign goods—is the best prospect for both developed and developing countries to cultivate. Some of these countries have concentrated on exports and kept their own markets relatively closed, as a development strategy. Few nations have faced the kind of competitive pressure the United States is under. While some developed nations have labor costs comparable to those of the United States, most nations have much lower wages. U.S. capital costs have also been higher than those of most other developed nations. The combination of these disadvantages and the attractiveness of the American market to most foreign producers (in developed and developing countries alike) means that the United States must do a great many things very well, just to stay even with the competition.

Quite a few signs indicate that U.S. manufacturing is not staying even.

Signs of Weakness in U.S. Manufacturing

U.S. pre-eminence in many manufacturing industries has evaporated. For example, only one U.S.-owned company is still making color TV sets, and most of its production takes place in Mexico. No U.S. company makes video cassette recorders or compact disc players. Mass production of automobiles was invented in the United States, but others (especially the Japanese) are now leaders in the technology and management of auto manufacture. Of the 10.3 million passenger cars bought by Americans in 1987, 3.1 million came from Japan, despite the quota on these imports. Another 620,000 cars were built in North America in Japanese-owned plants; still another 1 million cars were imported from other countries.

What is behind these losses? There are signs that the United States is losing its once substantial edge in technology, a crucial factor in competitiveness for an advanced, high-wage nation. For example, the United States is spending a smaller share of gross national product on the kind of research and development likely to pay off commercially than its major competitors; U.S. civilian R&D spending was less than 1.9 percent of GNP in 1985, compared to Japan's 2.8 percent and West Germany's 2.5 percent. Japanese private businesses are even farther ahead in spending on R&D, devoting 2.1 percent of GNP to the purpose in 1986, compared to 1.4 percent for U.S. businesses.

In the human skills needed for technologically advanced manufacturing, the United States is also losing ground. We are graduating and using just over half as many engineers per capita as Japan; and our public schools are turning out young people who do not measure up internationally, especially in math and the sciences.

The heart of the matter, however, is whether American manufacturers have fallen behind in the practical application of technology. The available evidence suggests that they have. One study of flexible manufacturing systems—computer controlled systems that are designed to make different kinds of parts in small batches—concluded that American firms

have no edge at all in this advanced form of automated manufacturing. On the contrary, they used the technology far less effectively than the Japanese. The American flexible manufactured systems produced many fewer kinds of parts, took longer to develop, and performed less reliably.

Another example comes from auto design and manufacture. U.S. auto companies spend, on average, over 5 years taking a model from the initial concept to full production. Japanese companies take only a little over 3 1/2 years to do the same—and they do it with about half as many engineering hours. The Japanese advantage appears to come from such things as putting a single boss in charge of the project, getting the company's research/development/design people and its production people to communicate with each other, ironing out conflicts early, and treating product and process design as simultaneous rather than sequential.

There are other Japanese strengths. Among those most often cited are close attention to product quality and reliability, consensus building, and emphasis on long-term market share rather than short term profit. Not all Japanese firms share these characteristics, and some American firms do. But firsthand observation, case studies, and the remarkable record of Japanese industrialization and adaptation in the postwar period support the basic point: Japanese manufacturers have moved into a commanding position in many industries and have surpassed U.S. rivals in many important markets, by developing and applying technology.

U.S. manufacturers have responded to the Japanese challenge (and the challenges from Taiwan, Korea, Germany, and so on) in a variety of ways, some effective, and some less so. Overall, American manufacturing has not yet recouped the losses of recent years. As one departing chief executive officer of a major U.S. manufacturer told the *New York Times*: "Yes, American industry has improved over the past four or five years, but so have our competitors."[1]

A Manufacturing and Service Economy

The United States cannot do without a strong manufacturing sector. Manufactured goods are indispensable for trade with other nations. It is also clear that America has not entered a post-industrial stage in which demand for goods gives way to demands for services. Demand for manufactured goods is as great as ever—greater, for everything but the basics, food and fuel. American consumers, businesses and government now devote over 30 percent of all their spending to manufactured goods other than food and fuel, compared to 23 percent 30 years ago.

More fundamentally, to speak of services as taking the place of manufacturing is to overlook the strong interdependence of the two kinds of activities and the blurring of distinctions between them. Many service industries depend heavily on manufacturers for business. And some manufacturing industries could hardly exist without allied services—for example, the manufacture of computers and design of software, often by an independent firm.

1 Robert Anderson, former chief execurive officer, Rockwell International Corporation, quoted in Claudia H. Deutsch, "U.S. Industry's Unfinished Struggle," The New York Times, Feb. 21, 1988, sec. 3.

Manufacturing remains extremely important for employment in the U.S. economy. Nearly 28 million Americans—about one-quarter of the work force—make their living in manufacturing, either directly or in providing services or materials to manufacturing. Far from replacing manufacturing as source of employment, in the manner that manufacturing took the place of agriculture, service industries include a good many jobs that depend on manufacturing—and by and large, these are well-paying jobs. Not only are manufacturing wages, on average, higher than wages in the service sector; most of the jobs in services that are closely tied in with manufacturing also pay better than average. To keep those good jobs, America has to compete effectively in the production of goods, as well as the provision of services.

High technology industries cannot take the place of traditional manufacturing, any more than services can simply replace the manufacturing sector as a whole. Certainly, high tech industries are vital to the generation of jobs, wealth, exports, and the advance of technology in other industries. But they do not stand alone. The best customers of high tech industries such as semiconductors are other industries, both high tech (e.g., computers) and traditional (e.g., autos). Nor can the high technology industries, by themselves, compensate for trade deficits in declining traditional industries. The trade balance in high technology products shrank from a surplus of $27 billion in 1980 to a surplus of only $600 million in 1987—with an intervening deficit of $2.6 billion in 1986. U.S. high technology industries are still quite competitive, but they are unlikely to regain the dominance they enjoyed 10 years ago or to generate the large trade surpluses of that time.

Conclusion

Counting on the lower dollar alone to sell American manufactured goods is a shaky and potentially painful strategy. If the United States is to maintain its standard of living *and* live within its means, it will have to reduce the Federal budget deficit, increase its access to foreign markets, and make its manufacturing sector more competitive. As yet, some progress has been made on some of these fronts, but more ground remains to be gained. Improving manufacturing competitiveness—the ability to make high-quality goods at reasonable costs, without sacrificing our standards of living to get costs down—will be crucial if the United States is to remain a first-class economic power.

A Note About the Special Report

This special report is an interim product of the full assessment *Technology, Innovation and U.S. Trade.* This report describes the causes and anatomy of the U.S. trade deficit, and discusses the role and health of manufacturing within the U.S. economy.

The full assessment will analyze the record of American manufacturing companies in developing and applying new product and process technologies, with particular emphasis on how we have lost or could bolster technological advantages. The full assessment will also examine the extent to which high capital costs, and relationships of manufacturers with providers of capital, have limited the ability of U.S. manufacturers to make needed investments in technology development.

In addition, the full assessment will discuss how Federal government policies promote or hinder technology development and its application to manufacturing. It will assess how foreign government trade, industrial, and technology policies affect U.S. manufacturers' access to foreign markets and their ability to compete in the U.S. market. That part of the assessment will concentrate on Japan and Asia's newly industrializing countries, where the most significant technological progress has been and will likely be. The full assessment will also evaluate how U.S. trade policies have affected American manufacturing, both in promoting increased exports and in coping with rapidly rising imports. Policy options will focus on fostering technology development and application in manufacturing, building technological advantage, promoting exports and opening foreign markets, and alternatives for dealing with imports.

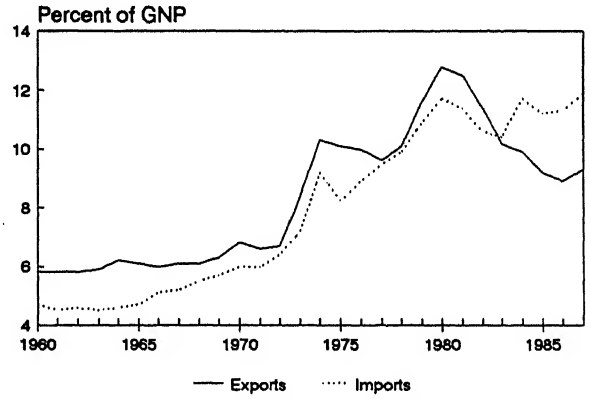
U.S. Trade Performance

A nation's economic health can be measured in many ways. Common measures include Gross National Product, per capita income, wages and unemployment rates, life expectancy, literacy rates and educational attainment. The balance of international trade is one important indicator of the ability of a nation's firms and industries to compete internationally. A nation's economic and technological strength and weaknesses are reflected in its trade figures.

In the mid-1980s, for the first time in recent history, the trade accounts of the United States have gotten seriously out of balance. In the 1950s and 1960s, the U.S. was accustomed to running modest trade surpluses. In the 1970s and early 1980s, small deficits began to appear, but both deficits and surpluses remained lower than one percent of GNP. In the mid-1980s, the trade deficit ballooned; in 1987, the current account deficit was a record-high $161 billion, or 3.6 percent of GNP[2] Before 1983, the current account surplus or deficit had not exceeded 1.2 percent of GNP.[3]

Simultaneously, the importance of international trade to the American economy was growing: imports of goods and services increased from 4.7 percent of GNP in 1960 to 12.2 percent in 1987, while exports expanded from 5.8 percent to 9.5 percent (figure 4).[4] The expansion was not smooth. In 1980, exports totaled nearly 13 percent of GNP, and have since fallen in percentage terms. Imports grew at about 8 percent per year, on average, from 1980 to 1987; meanwhile, exports grew unevenly, falling and then rising again for an average annual growth rate of

Figure 4
Goods and Services Trade, Percent of GNP
1960-87



SOURCE: U.S. Department of Commerce, Bureau of Economic Analysis, National Income and Product Accounts, Table 1.1, 1987 electronic data.

2 The United States keeps account of trade balances using a variety of partial balances, as discussed below.

3 U.S. Department of Commerce, Bureau of Economic Analysis, The National Income and Product Accounts of the United States, 1929-82, (Washington, DC: U.S. Government Printing Office, September, 1986); and U.S. Department of Commerce, Bureau of Economic Analysis, Survey of Current Business, various issues.

4 Ibid.

3.2 percent over the period. Before 1983, exports and imports tended to grow or fall together, as percentages of GNP. It is the marked divergence of imports and exports that accounts for the unprecedented deficits of the 1980s.

The dominance of the United States in world markets in the 1950s and 1960s was never expected to be a permanent condition. Europe and Japan were rebuilding their industrial bases after the devastation of World War II, often using newer and more efficient technologies. The international trading system of the General Agreement on Tariffs and Trade, and various programs of economic development aid, were designed to help both war-ravaged industrial nations and developing countries along. The fact that many newly industrialized nations in Asia and Latin America were able to achieve rapid growth in the past few decades is at least partly testament to the success of such programs. Often, in order to develop or rebuild, developing and developed countries alike controlled access to their own markets, using them as incubators for their own developing industries. While these developments can all be viewed positively, as contributing to world economic growth and development, they have also begun to present problems for American industries. Limited access to many foreign markets presents problems for U.S. exporters, while relatively open access to our own market given to countries such as Japan, Taiwan, West Germany, South Korea, etc. increases the competition at home.

In short, the fact that American dominance in world goods markets has slipped is expected and even partly self-imposed. So why do we view our trade deficits as a problem? In part, the speed of the decline in the late 1970s and throughout the 1980s has been unsettling; but more fundamentally, we are concerned that the responses U.S. manufacturers and government have made to the decline are inadequate to stem further losses. The losses are beginning to hurt. Many manufacturing industries are in trouble, employment has fallen, whole communities in older industrial areas are in decline, and wages of manufacturing workers have stabilized well below their historical peak, in real terms. The trade deficit, then, is a manifestation of a set of problems that could well become much worse.

Proposals for "solving" the deficit are nothing if not diverse, ranging from upgrading the skills of the workforce to crafting new ways of dealing with unfair trade. Some observers counsel little action at all. They see the deficit as self-correcting, and caution that government interference with trade regimes or factors determining trade will prove counterproductive in the end. Different views on what should be done—or not done—about the trade deficit stem partly from different opinions on the importance of its causes. Regardless of the policy prescription, however, an overview of the composition of the trade deficit makes it clear where the potential problems are, and equally important, where they are not.

What is the Trade Deficit?

Strictly speaking, there is no such thing as "the trade deficit." Most often, "the trade

deficit" is synonymous with the merchandise (or goods) trade deficit, which is only one of the partial balances commonly used to express the position of the United States in international flows of goods and services. There is no single indicator that accurately and wholly reflects this position.[5] Rather, international flows of goods, services, and capital are included in the U. S. balance of payments statements (table 1). Partial balances—such as the current account, the merchandise trade account, and the balance on goods and services—reflect the net debit-

Table 1.—Simplified U.S. Balance of Payments Statement

Credits (receipts)	Debits (payments)
Current accounts:	Current accounts:
1. U.S. merchandise exports	1. U.S. merchandise imports
2. U.S. services sold to foreign residents a. Foreign tourist expenditures in the U.S. b. Fees and royalties from foreigners c. Transportation, insurance and other private and government services d. Receipts of income from U.S. (government and private) investments abroad	2. Services purchased from foreign residents a. U.S. tourist expenditures abroad b. Fees and royalties paid to foreigners c. Transportation, insurance and other private and government services d. Payments of income on foreign (government and private) investments in the U.S.
3. Unilateral transfers received from abroad a. Private remittance b. Pension payments c. Government grants	3. Unilateral transfers sent abroad a. Private remittance b. Pension payments c. Government grants
Capital account:	Capital account:
1. Net change in investment by foreigners in the U.S. a. Direct investment b. Indirect investment c. Foreign bank loans to U.S. residents d. Deposits by foreigners in U.S. banks e. Other	1. Net change in U.S. investment abroad a. Direct investment b. Indirect investment c. U.S. bank loans to foreigners d. Deposits by U.S. residents in foreign banks e. Other
2. Net change in foreign official reserve assets in the U.S. a. U.S. Government securities held by monetary authorities b. Other dollar and dollar-denominated assets held by foreign monetary authorities	2. Net change in U.S. official reserve assets abroad a. Gold b. Special drawing rights (SDRs) c. U.S. reserve position in the IMF d. Foreign currencies
3. Allocations of special drawing rights (SDRs)*	
Total credits	Total debits

*Capital account 3. has an entry only in years when the International Monetary Fund allocates SDRs to member countries.

SOURCE: Arlene Wilson, "U.S. Trade and Payment Balances: What Do They Mean?" Congressional Research Service Report 85-26E (Washington, DC: Library of Congress, 1985).

5 Arlene Wilson, "U.S. Trade and Payments Balances: What Do They Mean?" Congressional Research Service Report No. 85-26 E, January 23, 1985.

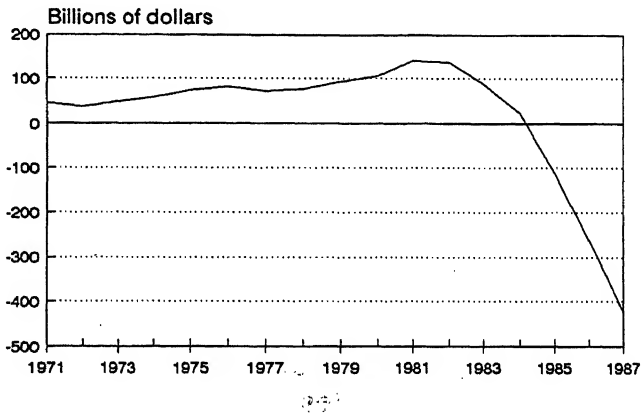
credit position of that part of U.S. international trade and transactions.

The entire balance of payments account must, as the name implies, balance. Its two components, the capital account and the current account, mirror each other, at least in theory.[6] A current account deficit must be balanced by a capital account surplus of the same amount; without capital funds coming in from abroad, something else would have to give—consumption, investment, imports, government spending, or all four.[7] The current account measures international flows of goods, services, and unilateral transfers, while the capital account includes flows of direct and indirect investment and changes in official reserve assets.

The current account—the most comprehensive measure of trade in goods and services—was relatively stable for two decades following World War II, becoming more volatile after 1970 and plunging deeply into deficit after 1981 (see figure 1). The capital account, therefore, had to show a corresponding surplus—also unprecedented. As a corollary, the international investment position of the United States has shifted from surplus to deficit in the 1980s, roughly balancing the shifts in the current account. That is, foreign investment in the United States exceeded American investment offshore by nearly $424 billion in 1987 (figure 5). This infusion of capital allows the United States to sustain its current account deficit, or to consume more goods and services than it produces.

A nation's ability to consume more than it produces is attractive from the standpoint of the consumer—while it lasts. In this sense, the current account deficit has benefitted many Americans in the short term. But a nation cannot go on forever paying for its current account deficit through a surplus in the capital account. The capital account surplus consists of savings from other nations, which are invested in the United States in order to

Figure 5.
Net U.S. International Investment Position



SOURCE: U.S. Department of Commerce, Bureau of Economic Analysis, Survey of Current Business, June, 1987, U.S. International Transactions, table 1

provide future returns. Those returns will eventually drain away funds that, if they had gone into the hands of U.S. nationals, might have been used for American consumption, investment, or public spending. Moreover, foreign investors cannot invest larger and larger amounts of money in the United States indefinitely. At some point, con-

6 In practice, there are differences (called statistical discrepancies) between the dollar amount of the capital and current accounts. Moreover, the capital and current accounts do not necessarily balance at any particular point in time it may take many months for the adjustments in one account to cause changes in the other to show up. For a discussion of these accounts and explanations of the items in each account, see Arlene Wilson, op. cit.

7 For further discussion of the relation between the current account deficit and an influx of foreign capital, see the section on The Causes of the Deteriorating Trade Balance, The Macroeconomic Argument.

fidence that U.S. investments can continue to yield higher returns, or more reliable returns, will erode, or the supply of foreign savings will be curtailed, and the massive flows of foreign capital into the United States will dry up.

No one can pinpoint the time when this will happen. But most analysts expect that foreigners will cease to finance our large current account deficit within a few years at most.

The trade deficit for 1988 promises to be smaller than the one in 1987—the first change in this direction since 1980. While this reduction in the trade deficit is relatively small, further, more consequential changes in our current account are coming, and they will necessitate adjustments on our part. What kind of adjustments? To get some insight on this question, it is helpful to look at the components of international trade—what kinds of goods, services, or other exchanges are most important to trade, and where the United States is running its biggest deficits.

Manufacturing and the Merchandise Trade Deficit

The current account measures what we commonly think of as international trade—exports and imports of goods and services, plus unilateral transfers.[8] The merchandise trade deficit, reflecting international flows of goods, is larger than the current account, mainly because the United States runs a surplus in international trade in services. In 1987, the current account deficit was $160.7 billion, with a surplus of $14.3 billion in services trade and a deficit of $159.2 billion in merchandise trade.[9]

To reduce the current account deficit, the United States must reverse the deficit in merchandise trade.[10] Surpluses in services alone cannot make much of a dent in the current account; they are dwarfed by the deficit in merchandise trade. Two kinds of activities are included in the services accounts: investment income (e.g., dividends and interest), and trade in services such as banking, insurance, travel, and license and royalty payments. In 1987, investment income, according to Commerce Department figures, produced a surplus of $14.5 billion, but trade in service activities was slightly in deficit, to the tune of $200 million.

In an earlier assessment, OTA found that the official figures have consistently understated the surplus from services trade (banking, travel, and the like).[11] For example, the Commerce Department figures showed a small surplus for services trade of $2 billion in 1984, whereas the OTA mid-range es-

8 Unilateral transfers include U.S. Government grants (excluding military grants of goods and services), U.S. government pensions and other transfers, and private remittances and other transfers.

9 The remaining deficit of $12.8 billion was accounted for by unilateral transfers. In this section, trade figures are drawn from the national income and product accounts, which are calculated by the Commerce Department's Bureau of Economic Analysis on the free-along-side (f.a.s.) basis. Other trade figures, kept on a more current basis by the Commerce Department's International Trade Administration, calculate imports on the cargo-insurance-freight (c.i.f.) basis. Imports figured on the c.i.f. basis are higher, and thus make the U.S. trade deficits appear higher (or the surpluses lower).

10 Much of this section depends on a presentation entitled "U.S. Trade Deficits and International Competitiveness," by Allen Lenz, former director, Office of Trade and Investment Analysis, Department of Commerce.

11 U.S. Congress, Office of Technology Assessment, Trade in Services: Exports and Foreign Revenues, OTA-ITE-316 (Washington, DC: U.S. Government Printing Office, September 1986), ch. 4.

timate of the surplus for that year was $14 billion. Nonetheless, even using OTA estimates, the surplus for services is small compared to the merchandise trade deficit. Furthermore, the surplus from services trade was shrinking in the years OTA made its calculations (1982 to 1984). Investment income has been quite considerable in previous years, peaking at $34.1 billion in 1981, but it too is declining. Because the United States is now the world's leading debtor, it seems likely that investment income will continue to decline for some years.

Are services on the brink of assuming much greater importance in international trade, perhaps eclipsing goods? OTA judges that they are not.[12] Goods can be shipped and stored; services, by and large, cannot. Most services are produced very near the place they are consumed. For that fundamental reason, goods are much more important to international trade than services and are likely to remain so for a long time. This situation may change as telecommunication becomes cheaper and more reliable, but the changes are likely to be gradual, not revolutionary. Moreover, it is not realistic to think of services trade as a replacement for trade in goods. The manufacture of goods and provision of services is highly interdependent. If American-made goods become more in demand and sell better around the world, many services will be bundled along with sales of those manufactured items. For example, the companies that have succeeded best in selling computers in the world market are also very good at providing services such as systems integration, training, maintenance of hardware and provision of up-to-date software.

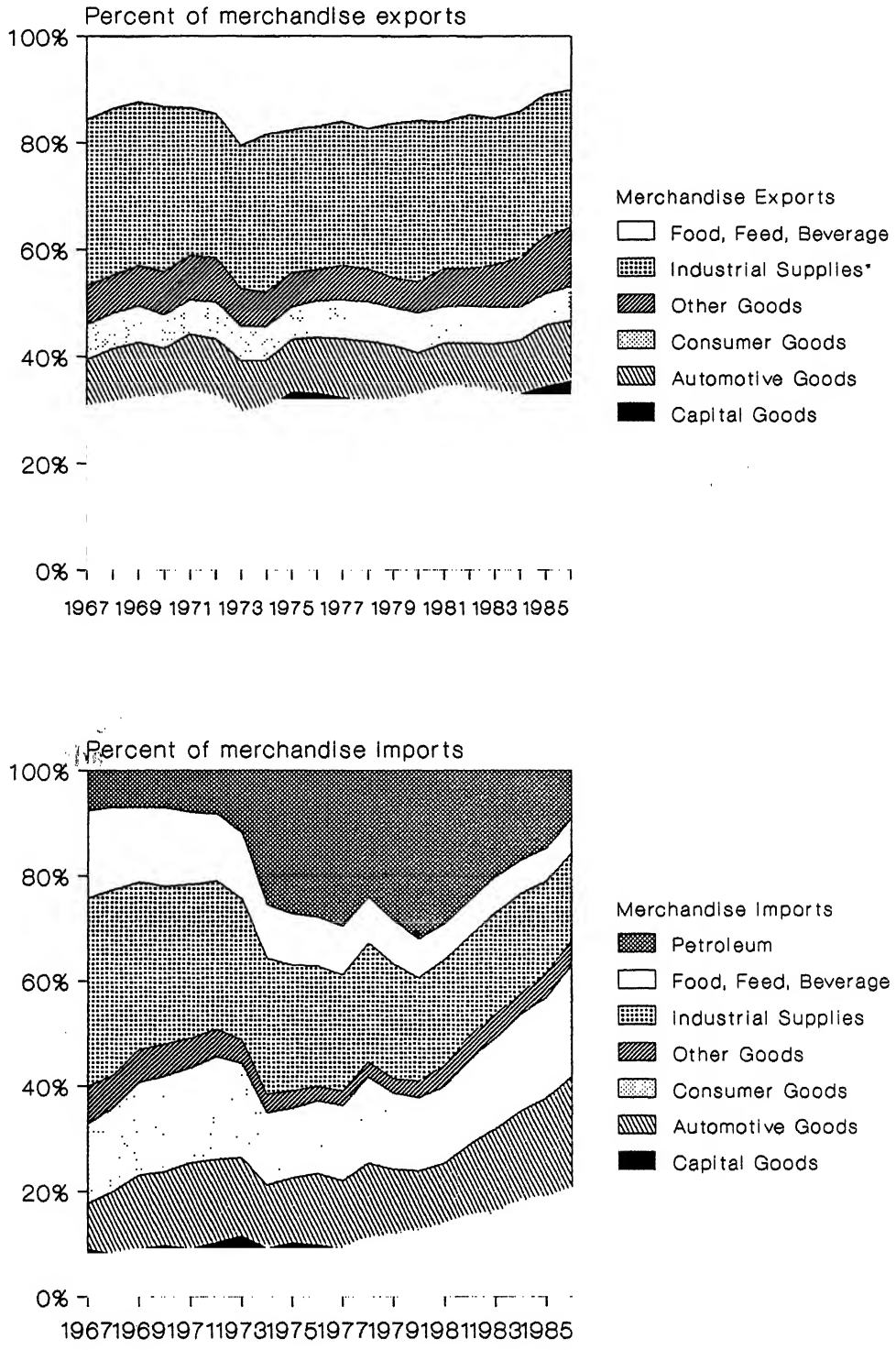
For different reasons, agriculture cannot do much either to reverse the current account deficit. Agriculture, where America is generally thought to be internationally competitive, contributed fairly strong trade surpluses in the 1970s, helping to offset the petroleum deficits of that time and to keep the current account more or less in balance during the decade. But agricultural trade surpluses have dwindled in recent years. Farm support programs and the widespread dispersal of production-enhancing agricultural technology throughout the world have reduced the potential for American exports. Even if U.S. agriculture were to recover some foreign markets, agricultural trade, like trade in services, is too small to much affect the huge merchandise trade deficits of the 1980s.

Manufactured goods dominate merchandise trade. (Figure 6 shows the composition of merchandise trade over the past two decades.) About 80 percent of merchandise trade, both imports and exports, is in manufactured items. Thus, most of the merchandise trade deficit—and therefore, the current account deficit—is in manufactured goods. The great deterioration of the 1980s in the merchandise trade balance was due almost entirely to manufacturing. The deficit in petroleum trade, once a major drag on merchandise trade balances, improved by over $40 billion between 1981 and 1986, as oil prices fell and U.S. production increased, though this situation is temporary.[13] The agricultural trade surplus declined from $25

12 U.S. Congress, Office of Technology Assessment, International Competition in Services, OTA-ITE-328 (Washington, DC: U.S. Government Printing Office, July 1987), ch. 1.

13 For reasons why this is so, see U.S. Congress, Office of Technology Assessment, U.S. Oil Production: The Effect of Low Oil Prices, Special Report (Washington, DC: U.S. GPO, In Press).

Figure 6.
Composition of U.S. Merchandise Exports and Imports 1967-86



SOURCE: U.S. Department of Commerce, Bureau of Economic Analysis, Business Statistics: 1986, (Washington, DC: U.S. Government Printing Office, 1987), Appendix II, U.S. International Transactions, p. 246; U.S. Department of Commerce, Bureau of Economic Analysis, Survey of Current Business, March, 1988, p. 44-46

billion to $3.4 billion. But the trade balance on manufactured products, having fluctuated moderately during the 1970s, plunged into deep deficit in the 1980s (see figure 2). Despite the upturn in exports in 1987, the manufacturing trade balance dropped to a record deficit of $138 billion as imports of manufactured goods continued apace.

One way to reverse the current account deficit is for U.S. exports to grow much faster than imports, and continue doing so for some time. But this is now likely. If import growth continues unchecked, it is highly unlikely that exports could grow fast enough to close the trade deficit; this would require extremely rapid expansion of exports, and assumes an improbably high rate of growth in world markets. It is more likely that U.S. import growth will slacken or reverse, either because of a recession that cuts consumption, or because the falling dollar makes imports too expensive for Americans to afford, or because we replace some imports with domestic production. At the same time, exports are likely to pick up, as foreign firms and consumers adjust to lower-priced American products. Indeed, U.S. merchandise exports grew consistently throughout 1987, rising to $258 billion. The degree to which exports can expand further will depend on many factors, including the value of the dollar, the competitiveness of U.S. manufacturing firms, and the economic and trade policies of many countries, not least our own.[14] The following section considers how these same factors were involved in causing the deepening trade deficits of the 1980s.

14 Why the trade deficit must turn around and how it may occur is discussed in more detail in the concluding sections of this report.

The Causes of the Deteriorating Trade Balance

The trade deficit cannot be attributed to any single cause. The rising value of the dollar, for example, is behind some of the deterioration in the trade accounts, but what caused the dollar's value to rise and remain high for such a long time? And how do we explain the fact that merchandise trade deficits—albeit modest ones, from the perspective of 1987—were becoming routine in the 1970s, during which time the dollar's value fluctuated? Teasing apart the various factors behind the trade deficit is like untangling a plate of spaghetti. A complex of forces, acting together, created the situation we have now. These can be divided into two basic categories: macroeconomic forces and the declining competitiveness of U.S. manufacturers.

The Macroeconomic Forces

The role of macroeconomic factors in shaping U.S. trade has been and will continue to be enormously important. Note that the emphasis here is on macroeconomic forces—there are many. Many analyses have seized upon one factor—the U.S. federal budget deficit, for example, or the overvalued dollar—as *the* explanation. This kind of analysis implies (and some state) that making the needed change in the one variable would solve the trade deficit.

Undoubtedly, the rise of the dollar and its persistently high value during much of the early 1980s was important. Similarly the Federal budget deficit was an important part of the chain of events and actions that led to the dollar's ascent. Focusing exclusively on either of these factors, however, is like identifying two strands of spaghetti as the whole meal.

To understand the complex of macroeconomic factors behind the trade deficit, it is important to remember that the current account deficit must be matched by a capital account surplus. In effect, the United States has been able to consume more goods than it has produced since 1981 (or run a current account deficit) by borrowing from abroad (or run a capital account surplus). That the United States was able to attract so much capital was unexpected. Before the 1980s, conventional economic wisdom, based on previous experience, held that consumption in excess of production was a transitory phenomenon; the current account deficit would set in motion a series of events (primarily, currency devaluation) that would eliminate the deficit. To understand why these events did not happen—or more precisely, have not happened yet—we must look at a series of actions, in the United States and abroad, in the 1980s.

One of the most significant changes effected by the Reagan administration in its early months was a shift to a more expansionary fiscal policy. The tax cuts for individuals and businesses were intended as a stimulus. It is doubtful that the primary purpose of the other major shift—an increase in government spending, primarily in defense—was fiscal stimulus, but combined with the tax cuts, that was the result.

Between 1981 (when the Economic Recovery Tax Act was passed and the administration's fiscal policies began to take effect) and 1987, Federal government purchases of goods and services increased by 7.8

percent annually; total government purchases of goods and services (including purchases by State and local governments) rose at an annual rate of 7.7 percent. Expenditures for defense dominated the increase in Federal purchases. They rose at an annual average rate of 9.9 percent; nondefense expenditures increased at an annual rate of 2.3 percent.[15] Significantly, government purchases of goods and services grew at a faster rate than the GNP, which rose at the annual rate of 5.9 percent.

While government expenditures were rising at a relatively rapid pace, receipts grew sluggishly. Federal government receipts—including personal tax and nontax receipts, corporate profits tax accruals, indirect business taxes, and contributions for social insurance—went up only 5.3 percent per year between 1981 and 1986. That difference of 3.3 percentage points per year between government expenditures and receipts inexorably deepened the Federal government deficit, which increased from $64 billion in 1981 to $205 billion in 1986—the largest peacetime Federal deficit ever. In 1987, the gap was narrowed, as expenditures stayed almost flat while receipts rose over 10 percent; the resulting deficit was still $152 billion.

What happened to the other components of GNP, while the Federal government's share was increasing? GNP can be disaggregated in a variety of ways, but the basic formulation is this: GNP equals the sum of government expenditures for goods and services, gross private investment, personal consumption, and net exports. All government expenditures for goods and services—which, in terms of its percentage of GNP, has been on a general downward trend over the postwar period—began to increase from its low point in 1979 (about 19 percent of GNP) to reach its current level, about 20.5 percent in 1987.[16] The increase is disproportionately a result of Federal government spending for goods and services, whose share of GNP increased from about 7 percent in 1979 to about 9 percent in 1987 (figures 7 and 8).

Gross private investment is composed of investment in nonresidential structures, producers' durable equipment, residential investment, and change in business inventories. In the past 40 years, gross private investment has fluctuated without any discernible long-term trend.[17] Investments in producers' durable equipment, however, has been trending slightly upward since the early 1960s, and maintained a share of GNP well within the recent historical range of variation during the 1980s. The tax cuts of the Economic Recovery Tax Act of 1981 (ERTA) affected both businesses and individuals. ERTA made it more profitable for businesses to invest, particularly in buildings and equipment.[18] As a result, private investment increased 5.8 percent per year between 1981 and 1986. This rate of growth is slight-

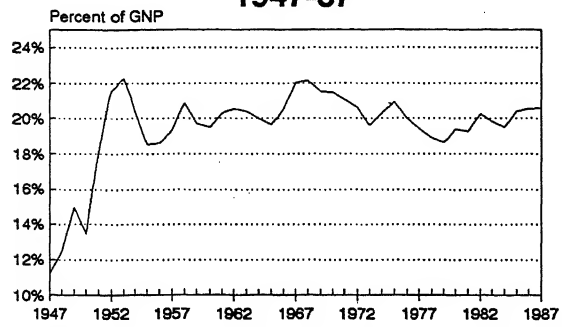
15 U.S. Department of Commerce, Bureau of Economic Analysis, "National Income and Product Accounts Tables," Survey of Current Business, June 1987; and U.S. Department of Commerce, Bureau of Economic Analysis, The National Income and Product Accounts of the United States, 1929-1982 Statistical Tables (Washington, DC: U.S. Government Printing Office, September 1986).

16 This does not include transfer payments, such as Social Security, Medicare, welfare payments, and Medicaid. Transfer payments have risen greatly during the postwar period. In the GNP accounts, transfer payments are included in personal consumption.

17 No trend is discernible in nominal dollars. Although GNP disaggregations are available in deflated dollars, many of the constant-dollar series show trends that seem to belie other well-established data and evidence. For example, in deflated (1982) dollars, net exports in the national income and product accounts were negative (implying trade deficits) during much of the 1960s, but positive during much of the 1970s. OTA is currently investigating how constant-dollar series are generated, in order to understand the apparent anomalies of constant-dollar figures. For now, trends in components of GNP over time are reported in nominal dollars.

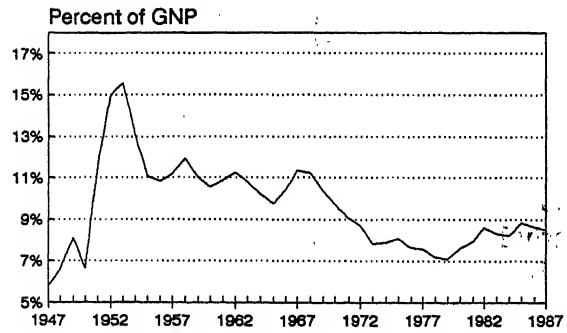
18 Stephen A. Meyer, "Trade Deficits and the Dollar: A Macroeconomic Perspective," Federal Reserve Bank of Philadelphia Business Review, Sept.-Oct. 1986.

Figure 7.
All Government Purchases, Percent of GNP
1947-87



SOURCE: U.S. Department of Commerce, Bureau of Economic Analysis, National Income and Product Accounts, Table 1.1, electronic data, 1987.

Figure 8.
Federal Government Purchases, Percent of GNP



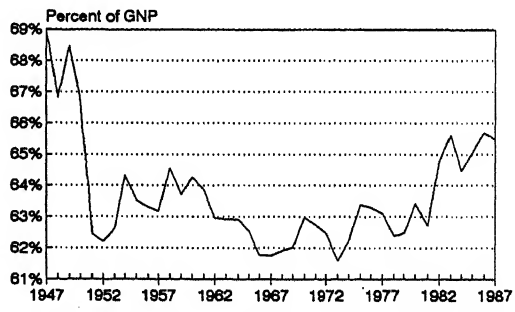
SOURCE: U.S. Department of Commerce, Bureau of Economic Analysis, National Income and Product Accounts, Table 1.1, electronic data, 1987.

ly slower than the rate of growth of GNP, but this is partly a result of the fact that gross private investment was already quite high in 1981, compared with any previous year or with 1982 and 1983. If 1980 is chosen as the starting point, the rate of growth of private investment was 7.8 percent annually; if 1979 is the starting point, the rate of growth was 6 percent. In short, private investment roughly kept pace with GNP in the 1980s, and fluctuated within a range that was normal for the postwar period. What is surprising about this, however, is that investment maintained its share of GNP during a period of high (by historical standards) real interest rates.

Personal consumption is composed of expenditures on durable goods, nondurable goods, and services. Personal consumption, as a percent of GNP, has risen sharply in the 1980s. The percentage share fluctuated without much sign of a long term trend from the 1950s through the 1970s, varying between about 62 percent of GNP and 64 percent (figure 9). In 1982, after the recession, personal consumption expenditures shot up to about 65 percent, and rose again in 1984 to two-thirds of GNP. According to many economists, consumer spending has buoyed the economic recovery since the 1982 recession.

The story is different for net exports. From the 1950s until 1983, net exports' share of GNP fluctuated within historical norms. After 1983, as would be expected from the performance of other trade accounts, the percentage share plummeted, becoming a drain on GNP to the tune of nearly -3 percent per year by 1987.

Figure 9.
Personal Consumption, Percent of GNP



SOURCE: International Monetary Fund, International Financial Statistics, 1987 Yearbook, and Vol. 41, No. 4, (Washington, DC: International Monetary Fund, 1987, 1988) p. 229, 299, 523.

In sum, the three largest components of GNP—government spending, consumption, and investment—continued at normal or higher-than-normal rates, while the Federal government deficit mushroomed. The large budget deficits increased the demands on capital and raised interest rates, particularly relative to interest rates in other developed nations (figure 10). Rather than crowding out private investment, though, the high interest rates unexpectedly served to draw in capital from other countries. At about the same time, around 1982, the growth of U.S. investment abroad slowed (figure 11).

As noted, this sequence of events was quite unexpected. International interest rates have diverged before without causing the massive and sustained inflow of foreign capital that the United States experienced in the 1980s. One important difference with past periods was that, in contrast to the United States, most developed nations were pursuing different macroeconomic policies, contracting their national budget deficits and easing the pressure on capital. In the rest of the OECD nations,[19] the public sector budget deficit rose only 1 percentage point of GNP between 1979 and 1982, while in the United States it rose 5.5 percentage points. Moreover, there were surplus savings in the other OECD nations during the recovery from the 1982 recession.[20] Since these surplus savings were not needed in these nations to finance their own deficits, and U.S. interest rates were high, the United States became an attractive place to invest foreign savings.[21]

The demand for dollars to invest in dollar-denominated assets pushed the dollar's value up relative to the currencies of most of our trading partners.[22] By 1981, the real exchange value of the dollar was headed upward, and the rising trend persisted until the first quarter of 1985.[23] Overall, the dollar appreciated 49 percent, in real terms, against the deflated currencies of major trading partners of the United States, between 1980 and 1985. Imports were cheaper, exports became more difficult to sell, and the trade accounts of the U.S. plunged into deep deficit.

The macroeconomic forces responsible for this situation were multiple. The combination of fiscal stimulus in the United States and contraction abroad, rising consumption and rapid recovery of investment after the 1982 recession, changes in tax law, rising interest rates in the United States and relatively constant interest rates abroad, and the slow recovery of investment in other OECD nations all played a part. In addition, the debt crisis in countries such as Brazil and Mexico

19 OECD is the Organization for Economic Co-operation and Development, and its member nations are Australia, Austria, Belgium, Canada, Denmark, Finland, France, the Federal Republic of Germany, Greece, Iceland, Ireland, Italy, Japan, Luxembourg, the Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, Switzerland, Turkey, the United Kingdom, and the United States.

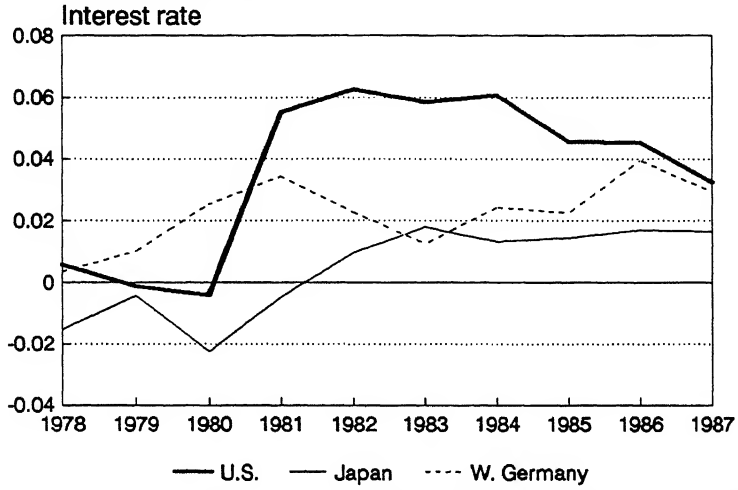
20 Stephen Marris, Deficits and the Dollar: The World Economy at Risk (Washington, DC Institute for International Economics, December 1985), pp. 8-11.

21 Another explanation that was advanced for the strong flow of foreign investment funds to America was that the United States represented a safe haven in a troubled and uncertain world. This argument, while popular, is not particularly persuasive. First, inflows of foreign capital were much the same in 1979-80, when the U.S. economy was perceived as unstable, as in 1983-84, when a strong recovery led to perceptions of a safe haven in America. Furthermore, the pull of high real interest rates is probably a sufficient explanation for the inflow of foreign capital. See Marris, op. cit., pp. 28-9, and William H. Branson, "Causes of Appreciation and Volatility of the Dollar," NBER Reprint No. 785 (Cambridge, MA: National Bureau of Economic Research, Inc., 1985).

22 Canada is something of an exception; the Canadian dollar was already weak relative to the American dollar, but became weaker. Some of the Asian NICs' currencies did not depreciate very much, in some cases because they were pegged to the dollar.

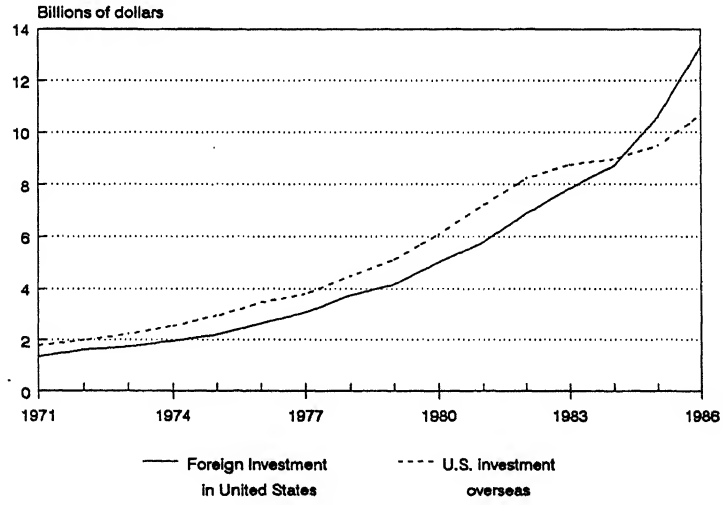
23 See, for example, Paul R. Krugman and Richard E. Baldwin, "The Persistence of the U.S. Trade Deficit," Brookings Papers on Economic Activity, 1:1987; and Meyer, op. cit. Meyer also points out that the dollar's value rose by 18 percent relative to Canadian dollars, 18 percent against the Japanese yen, 89 percent against the German mark, 117 percent against the British pound, and 149 percent against the French franc between 1980 and its peak in 1985.

Figure 10.
Short Term Real Interest Rates, United States, Japan, and West Germany



SOURCE: International Monetary Fund, International Financial Statistics, 1987 Yearbook, and Vol. 41, No. 4, (Washington, DC: International Monetary Fund, 1987, 1988) p. 229, 299, 523.

Figure 11.
U.S. International Investment Position Cumulative, 1971-86



SOURCE: U.S. Department of Commerce, Bureau of Economic Analysis, Survey of Current Business, June, 1986, U.S. International Transactions, table 1.

curtailed U.S. exports to those countries. It is tempting to zero in on one thing—most commonly, the value of the dollar or the budget deficit—but this kind of oversimplification is misleading when it comes to choosing the policies necessary to remedy the situation, and raises false hopes of a single silver-bullet solution.

It is equally wrong to focus on macroeconomic causes of the trade deficit, and macroeconomic solutions, ignoring the competitiveness issue. Far too much analysis has been devoted to trying to prove that *either* macroeconomic factors *or* competitiveness is the root of the trade deficit, without recognizing the interplay and synergism between them.

The Declining Competitiveness of U.S. Manufacturing

Several features of the trade picture in the past two decades indicate that the United States—more specifically, U.S. manufacturing—has lost competitive prowess. Since the 1970s, it appears that the United States has been able to keep its international trade accounts out of the red only when the dollar is declining. The strength of the dollar in the 1980s was not a unique occurrence in our history: by some measures, the dollar's peak value in 1985 was comparable to its exchange-rate value in 1970. But in 1970 the United States had a current account surplus of $2.3 billion, compared with deficits of $107 billion in 1984 and $116 billion in 1985.[24]

It is noteworthy that U.S. current account and manufacturing trade performance began deteriorating *before* the rise of the dollar (see figures 1 and 2). When agricultural exports and petroleum imports—the two largest sources of nonmanufactured items in the merchandise trade account—are subtracted from merchandise imports and exports, the picture that emerges is one of deepening U.S. trade deficits since the early 1970s. Significantly, the few years of surplus—1974, 1975, 1980 and 1981—were associated either with serious recessions (which generally jampen demand for imports) or with an exceptionally low dollar.

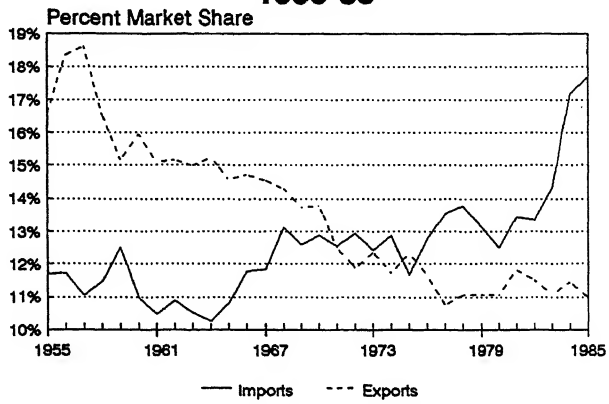
The trends in U.S. share of world markets tell much the same story. American manufacturers have been losing their share of both domestic and foreign markets for some time. Between 1970 and 1980, the U.S. share of world imports rose slightly, from 12.1 to 12.5 percent, but its share of world exports dropped from 13.6 percent to 10.9 percent (figure 12).[25] Between 1980 and 1986, American exporters' sales of manufactured items fell 15 percent, while countries outside the United States were increasing their imports from all sources by 22 percent (in volume terms).[26] Another calculation shows a general drop in the world market share of U.S. manufactures after 1975 (interrupted only by a brief rise at the end of the decade when the dollar fell), and then a steep

24 Krugman and Baldwin, op. cit., pp. 2-5. These authors present evidence suggesting that the real value of the dollar that would bring our trade into balance has declined over the long term.

25 United Nations, 1980 Yearbook of International Trade Statistics, Volume I: Trade by Country, Department of International Economic and Social Affairs Statistical Office, (New York: United Nations, 1981).

26 Rimmer De Vries and Derek Hargreaves, "The Dollar's Decline and Trade: Mission Accomplished?" Challenge, January-February 1987, p. 39.

Figure 12.
U.S. Share of World Import and Export Markets
1955-85



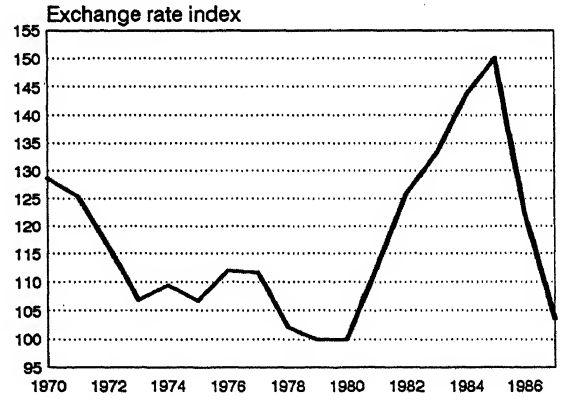
SOURCE: United Nations, International Trade Statistics Yearbook (United Nations: New York), Volume 1, table A, various years 1962-84.

decline of 8 percentage points from 1980 to 1985.[27]

Even U.S. exports of high-technology products—from the very sectors in which American firms are supposed to shine—have lost market share. Of ten high-technology sectors, only two—office, computing and accounting machines, and agricultural chemicals—gained in share of world exports between 1965 and 1980. Seven high-technology industries (engines and turbines, professional and scientific instruments, electrical equipment and components, optical and medical instruments, drugs and medicines, plastic and synthetic materials, and industries chemicals) lost shares of world exports, and one (aircraft and parts) remained about the same.[28] These losses of market share occurred *before* the rise of the dollar in the 1980s. Since the dollar's fall after 1985, America's high technology trade picture has improved somewhat. Following a deficit in 1986, high technology goods trade showed a small surplus of $600 million in 1987.

Another indicator of a decline in competitiveness is the remarkably slow response of U.S. imports and exports to the dollar's fall. From its peak in the first quarter of 1985, the dollar has fallen back to the lows of the late 1970s (figure 13). But the trade deficit has

Figure 13.
Index of Effective Exchange Rates for the U.S. Dollar, 1976-86
1980 = 100



27 Paul R. Krugman and George N. Hatsopoulos, "The Problem of U.S. Competitiveness in Manufacturing," New England Economic Review, Jan./Feb. 1987, p. 20. Krugman and Hatsopoulos have adjusted U.S. world market share data to eliminate two extraneous factors. First, the adjustment screens out the effects different economic performance of different regions or countries. For example, an economic slump in Europe might curtail European imports, thus reducing the American manufacturers' share of world markets without reflecting a fundamental improvement in competitiveness. Second, the adjustment includes the U.S. market is included in the world market.

28 Global Competition: The New Reality, Report of the President's Commission on Industrial Competitiveness (Washington, DC: U.S. Government Printing Office, January 1985), p. 6.

only just begun to fall substantially. In 1987, over 2 years after the dollar began to fall, the merchandise trade deficit set a new record of $159 billion.

That trade deficits should continue to rise for a time after a drop in the dollar's value is not unexpected. Since firms buying from overseas suppliers tend to make extended commitments, U.S. importers would normally continue to buy from offshore suppliers even after the dollar's adjustment. At the same time, importers must pay more for foreign-made goods when the dollar is falling, thus making imports more expensive. The case of exports is parallel. Even after the dollar's fall, U.S. firms wishing to sell offshore have to make special efforts to overcome buyer-supplier relationships built during the time when U.S. product prices were higher, and such efforts take time. This accounts for the usual and expected lag—known as a J-curve—between the adjustment of currency value and and a turnaround in the trade deficit.[29]

However, a lag of 3 years since the dollar peaked before seeing any really significant turnaround is unusual and surprising. The merchandise trade deficit abated somewhat in early 1988, but the deficit was still running at an annual rate of well over $100 billion. In contrast, the response to the dollar's rise—a rise in imports of manufactured goods and a drop in exports—was much swifter than the opposite adjustment when the dollar fell. This fact, in combination with others, suggests that U.S.-made goods are less attractive than foreign-made goods, the price effects of currency adjustment aside. In some cases, the attractiveness of foreign products reflects very low labor costs or government subsidy; in other cases it arises from high quality and reliability.

The trade picture outlined above is certainly not what one would expect of a nation whose manufacturing industries are holding their own in international competition. While trade and market share figures do not indisputably prove the case for loss of competitiveness, they are signs of trouble—especially since manufacturing trade slipped into deficit in the 1970s, with surpluses appearing thereafter only when the dollar's value dropped, or in recession years. And behind the aggregate trade figures are the experiences of individual industries: American manufacturers of consumer electronics, steel, automobiles, and semiconductors successively lost out to competitors who offered better quality goods or lower prices, and these losses began well before the damaging rise of the dollar.

Other indicators as well point to loss of competitiveness in manufacturing. There is evidence that the share of the manufacturing sector in the U.S. economy has declined, while consumption of manufactured goods, as a share of total spending, is greater than ever—the difference, of course, being made up by imports. Productivity growth of American manufacturing has lagged, especially behind Japan's. In addition, there are signs that American leadership in technology—the foundation for high productivity and excellence in manufacturing—is eroding. Further discussion of these trends and indicators appears in the following sections.

29 It is important to note, however, that while exports have risen since the drop of the dollar, imports have not fallen.

To put the different indicators into perspective, it is useful to define competitiveness. For a firm, competitiveness is the ability to design, develop, manufacture, and market products at home and in other nations, in competition with other firms.[30] For a nation, it means doing all this without a decline in the real standards of living of its citizens.[31] This means, for an advanced nation like the United States, exploiting technology, in its broadest sense, to provide the rising productivity and superior product quality that make goods from high-wage nations attractive and affordable.[32] Even with the dollar's fall, most nations have lower wages than the United States. Moreover, the range of products low-wage nations make is rapidly expanding. It is very risky—in fact, probably infeasible—to limit our production to only the most knowledge-intensive goods and services and jettison traditional sectors where low-wage nations have production cost advantages. We must compete effectively in many product lines with low-wage nations, and with producers from developed nations who have excellent records in product design and performance.

Not all the signs are negative. Some American industries perform much better than others; the United States is by no means at the bottom of the list among nations in competitive performance and some of the signs (e.g., growth in manufacturing productivity) have recently improved. Nor is it necessary for the United States to outstrip everyone else. Economic growth and rising living standards in other countries are inevitable and desirable. However, a relative decline in U.S. performance is a matter of concern, for that is the road to second-class economic status.

We have to recognize that it is difficult for a high-wage, highly productive nation like the United States to make the cost-saving, productivity-enhancing, quality-improving adjustments necessary to stay at the cutting edge. Despite the difficulties, it is necessary, in view of the efforts many developed and developing nations are making to catch up in technology and penetrate the American market—the richest, largest, and one of the most open in the world. Catching up is not easy, but is often a more straightforward and manageable proposition than staying ahead. Moreover, development aid and parts of the international trade regime (e.g., the Generalized System of Preferences, allowing special exemptions from tariffs to developing countries) are intended to help the process along. Policies of individual countries also have an important effect. Many nations—developed, less developed, and newly industrializing—have trade and industrial policies aimed at promoting exports while keeping their home markets relatively protected.[33]

30 U.S. Congress, Office of Technology Assessment, International Competitiveness in Electronics, OTA-ISC-200 (Washington, DC: U.S. Government Printing Office, November 1983), p. 4.

31 Global Competition, op. cit. p. 13.

32 Technology is here used to mean not only hardware and machinery, but also the software, human skills, and managerial know-how to put together all the elements of production effectively.

33 The conduct and performance of policies aimed at industrial development and competitiveness in several nations, including Japan and newly industrializing Asian countries, will be explored in the full assessment of Technology, Innovation, and U.S. Trade.

U.S. Leadership in Technology

If the United States can maintain a competitive advantage, it is likely to be built on technology.[34] The reason is simply that the United States has substantial competitive disadvantages relative to most other nations in some areas—for example, wage rates and capital costs. U.S. wages are among the highest in the world, and during the first half of the 1980s probably were the highest. The falling dollar has lowered American wages vis-a-vis those of a few other developed nations—in particular, West Germany and Japan—but, in general, American wages are still high compared with those of most of our trading partners. As for capital costs, U.S. interest rates were substantially higher in the 1980s than those in much of the rest of the world.

Technology has been a traditional source of U.S. strength, compensating for these disadvantages. Our technological advantage in the past rested on the invention of new products (e.g., Nylon, photocopy machines, integrated circuits), swift adoption and efficient manufacture of products invented elsewhere (e.g., electric generators, stainless steel, jet engines), and improvements in the manufacturing process. The last includes not only designing and using better equipment but also organizing work and managing people so as to make efficient use of the equipment.

The commonly used measures of technological advantage or progress are not very satisfactory. Most are indirect; for example, many are measures of inputs, such as spending on research and development, or they are rough proxies for outputs of R&D, such as patent grants. In general, they do not tell us much about how well technology is being used in the production of goods. It is impressive, however, that most of the conventional technology indicators point in the same direction, and so do case studies that measure more directly the practical use of technology in manufacturing. In relation to other countries and to our own history, the United States is losing ground.

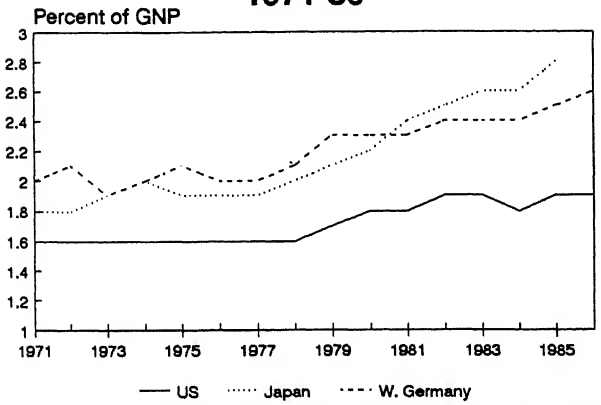
The dominating technological lead the United States enjoyed in the 1950s and 1960s was bound to narrow or disappear in many fields, since our advantage was in part the result of wartime destruction of European and Japanese industry. There are indications, however, that America's relative decline is not just the natural effect of growth in other countries but also reveals a fundamental weakening in our ability to use technology to make things cheaply and well.

Japan and Germany are ahead of the United States in the kind of R&D spending most likely to pay off commercially. Spending by American companies and government agencies for non-defense R&D rose quite steadily (in constant dollars) in the 1970s and 1980s, and in absolute terms the United States leads the world. But that lead simply reflects the size of the U.S. economy. In civilian R&D as a percentage of gross

34 In a few industries, competitive advantage may also be built on unique endowments of natural resources. For example, the American paper and lumber industries have substantial advantages over most other nations because of their access to a large, high quality softwood resource.

domestic product, we are trailing Japan and Germany by increasing margins (figure 14).[35] Our civilian R&D spending was 1.9 percent of GDP in 1985, compared to 2.8 percent in Japan and 2.5 percent in Germany. If defense R&D is included, total U.S. spending for R&D is about equal to Japan's and Germany's, as a percentage of GNP. However, the commercial payoff from defense R&D is uncertain; although it has sometimes been seminal for commercial applications, such spinoffs tend to be long-range and indirect.[36]

Figure 14.
Non-Defense Research and Development, Percent of GNP 1971-86



NOTE: Latest data for West Germany are NSF estimates based on preliminary national data.

SOURCE: National Science Foundation, International Science and Technology Update 1987 (NSF 87-319) (Washington, DC: 1987). p.7.

Japan has spurted still farther ahead in private business spending for R&D. In the early 1970s, the United States, Germany, and Japan were about on a par in business-funded R&D, as a percentage of gross domestic product (table 2). Today, Japanese companies are far ahead of their American counterparts, an indication of the seriousness of their commitment to technological eminence. German companies are also raising their rates of R&D spending faster than U.S. businesses, though not at the pace of the Japanese. Money spent on research and development is of course an imperfect measure of effective efforts toward technological progress; the money spent may or may not pay off in the marketplace. Even so, the fact that the Japanese and German leads are widening is reason for concern about America's future technological prowess.

In human resources devoted to R&D—another input measure—the United States is ahead, but the gap with other countries, especially Japan, is narrowing. In 1984, the

Table 2.—Business-Funded R&D As a Percentage of Gross Domestic Product

	1972	1981	1983	1985	1986
United States ..	0.99%	1.22%	1.32%	1.39%	1.42%*
Japan	1.15	1.73	1.99	2.09	2.14*
Federal Republic of Germany ..	1.08	1.46	1.56	1.64	1.69*

*Estimated.

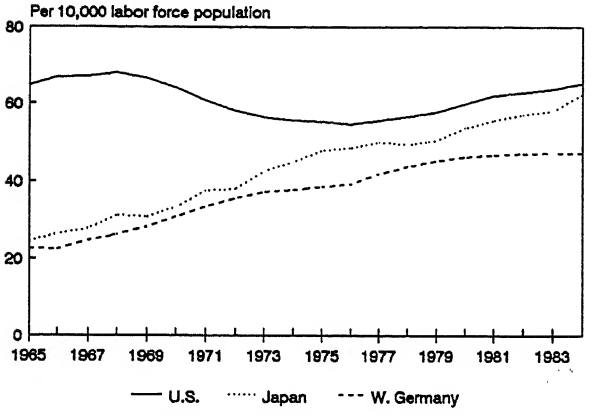
SOURCE: U.S. Congress, Office of Technology Assessment, *International Competition in Services*, OTA-ITE-328 (Washington, DC: U.S. Government Printing Office, July 1987), p.19.

35 Some analysts argue that the total amount of R&D spending in a nation is more significant than the amount of spending relative to GNP. However, spending as a share of GDP takes into account the size of the nation's economy and indicates how R&D ranks in importance in the nation's total expenditures.

36 U.S. Congress, Office of Technology Assessment, "R&D in the United States and in Other OECD Countries," staff paper prepared for the Subcommittee on Economic Stabilization, House Committee on Banking, Finance and Urban Affairs, November 1983.

number of scientists and engineers engaged in R&D, as a percent of the labor force, was still higher in the United States than in other market-oriented countries (figure 15), but Japan had almost closed on the U.S. level.[37] (There is no international information on the proportion of researchers working in the civilian versus the defense sector, but the Japanese defense sector is relatively small; most resources devoted to R&D are on the civilian side.)

Figure 15.
Scientists and Engineers in Research and Development, Per 10,000 Labor Force Population



SOURCE: National Science Board, Science and Engineering Indicators - 1987, (Washington, DC:National Science Foundation, 1987) p. 227, Appendix table 3-17

Other measures also document the Japanese challenge. For example, in 1983, Japanese universities graduated 69,600 bachelor-level engineers, while only slightly more—73,000 engineers—received bachelor degrees in the United States. Japan's labor force is barely more than half the size of ours.[38] University education of engineers in Japan may not be the equal of that in the United States; most Japanese engineers get extensive additional training on the job.[39] Nevertheless, Japanese industry has nearly twice the engineering graduates, per capita, to choose from and train if necessary. Moreover, in the United States, defense industries siphon off about 20 percent of the Nation's engineers. Engineering talent, as opposed to scientific, is indispensable for applying research to the development of new products and manufacturing processes.

In terms of our own past history, the number of engineers and scientists graduating from American universities is rising; in particular, more engineers than ever are receiving bachelor's degrees (figure 16). Doctoral degrees in engineering dropped off sharply, however, in the 1970s and despite a recovery had not regained the 1972 peak by 1985 (figure 17). The recovery depended almost entirely on an infusion of foreign students. In 1985, 57 percent of engineers getting doctoral degrees were foreigners.[40] Many of these foreign engineers remain in the United States, at least for a time, contributing especially to university faculties and to nondefense technology, since most defense work is done by U.S. citizens. But eventually a substantial number return home. Many American engineers see no need for a doctoral degree, since they can get a good job with a bachelor's or master's degree. But the sharp dropoff in doctoral degrees awarded to

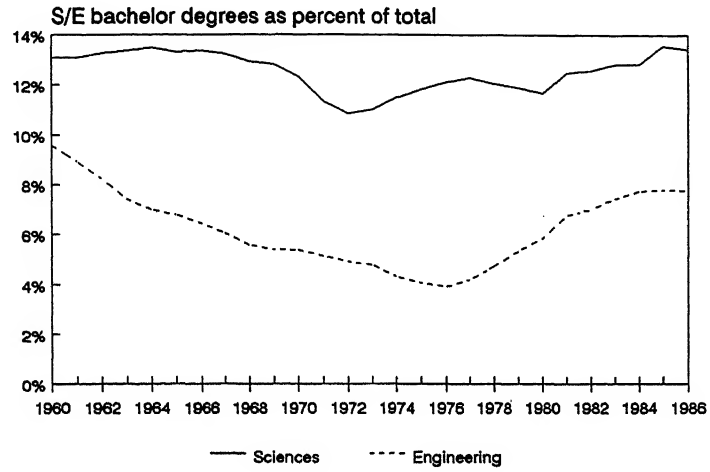
37 The Soviet Union claims a higher share of scientists and engineers in the labor force than any other major country. The Soviet Union's uneven record in technological performance (e.g., high in space exploration, low in production of consumer goods) reflects factors other than human resources devoted to science and technology.

38 National Science Foundation, International Science and Technology Data Update 1986, NSF-307, p.28. In 1982, more engineers received bachelor level degrees in Japan than in the United States (74,000 vs. 67,000).

39 See U.S. Congress, Office of Technology Assessment, International Competitiveness in Electronics, OTA-ISC-200 (Washington, DC: U.S. Government Printing Office, November 1983), pp. 314-17.

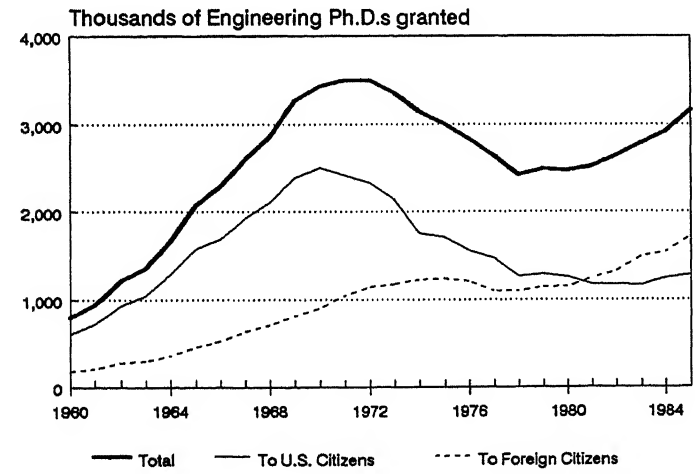
40 National Science Foundation, Foreign Citizens in U.S. Science and Engineering: History, Status, and Outlook NSF 86-305 Revised (Washington, DC, 1987).

Figure 16.
U.S.Science and Engineering Bachelor Degrees Granted, Percent of Total Degrees Granted



E: Office of Technology Assessment contractor report, "Federal Funding of Science and Engineering Education: Effect on Output of Scientists and Engineers, 1945-85," Betty M. Vetter (Commission on Professionals in Science and Technology) and Henry Hertzfeld (Consultant), NTIS order #PB 88-177 928/AS.

Figure 17.
U.S. Engineering Ph.D.s Granted to U.S. Citizens and Foreign Citizens, 1960-86



The totals do not equal U.S. recipients plus foreign recipients because the citizenship of some students is not known.

E: National Science Foundation, Foreign Citizens in U.S. Science and Engineering: History, Status and Outlook (Washington, D.C.: National Science Foundation, 1986), table B-21.

U.S. citizens may signal a serious problem in finding well-qualified engineers for research and teaching in universities—the seedbed for future engineering progress.

In other ways as well, Americans are lagging in the human skills needed to use technology to improve manufacturing. Our public schools are turning out graduates who do not measure up internationally. This is especially true in mathematics; for example, in an algebra test given to thousands of 12th grade students in 1982, American students came in 14th, just ahead of Thailand and behind Hungary. Hong Kong ranked first, slightly ahead of Japan. Maintenance and repair jobs, which are vitally important to computerized automation in manufacturing, require technicians with mathematical abilities. People who operate the computerized equipment need certain basic skills. They have to be able to read instructions, grasp the concept of statistical quality control, communicate with fellow workers, and understand their own part in a complex manufacturing process. However, it is not easy to measure how the lack of these skills exerts a drag on American manufacturing.[41] A strong argument can be made that failure of managerial skills has also been a serious handicap in the past 10 or 15 years, as one U.S. industry after another has lost competitive position. It is axiomatic, though, that a well-trained, well-educated work force is a positive force in maintaining technological advantage.

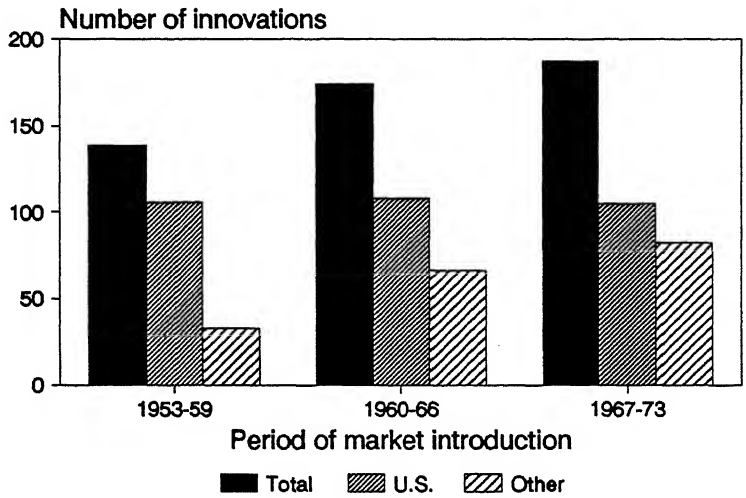
One way of evaluating the results of a nation's R&D efforts is to count up, in some fashion, the innovations it contributes. A well-known attempt at a cross-country comparison of innovativeness was the study sponsored by the National Science Foundation in the mid-1970s. Experts from six countries (the United States, Great Britain, West Germany, France, Japan, and Canada) selected and examined 500 technological innovations that were introduced into the international marketplace from 1953 to 1973.[42] Included on the list were such things as lasers, disc brakes for autos, fiber optics, a new antibiotic, and a camera with self-developing color film. The great majority of the innovations the group considered occurred in the United States (319 of the 500), but the share of U.S. innovations showed a declining trend over the 21 years (figure 18). No new international study of this kind has been done.

Another conventional indicator of R&D results is patent applications or grants. These data support the story of former American dominance and current decline, with the Japanese as principal challengers. U.S. patent data are especially telling. Patents granted to U.S. inventors peaked in 1971 (figure 19). By 1985, patents of foreign origin accounted for 46 percent of the total granted in the United States, with Japan—once again the leader among foreign nations—representing 19 percent. This record is all the more impressive in light of the fact that foreigners tend to patent only their more proven and useful developments in the United States, since it is expensive and inconvenient to apply for patents in countries other than one's own.

41 There is, however, a strong correlation between higher income and higher education, and low levels of education are strongly correlated with high unemployment rates. See U.S. Congress, Office of Technology Assessment, Technology and the American Economic Transition, OTA-TET-283 (Washington, DC: U.S.GPO, 1988)

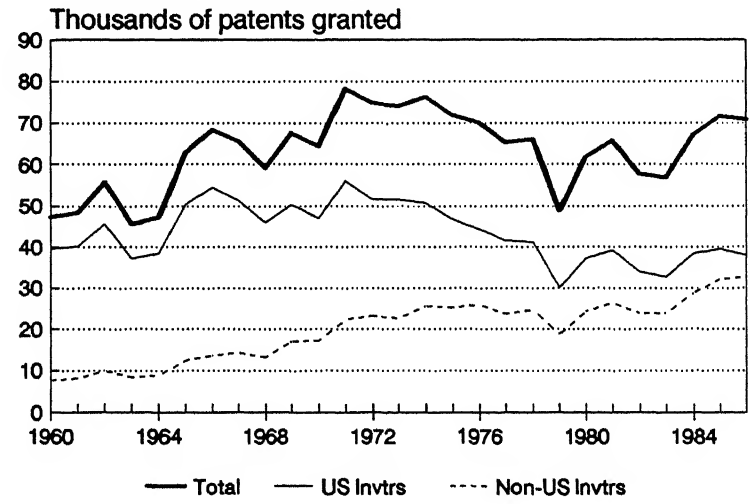
42 Gellman Research Associates, Inc., Indicators of International Trends in Technological Innovation, report prepared for the National Science Foundation under contract no. NSF-C889, April 1976.

Figure 18.
Trends in Technological Innovation



SOURCE: Research Associates Inc., Indicators of International Trends in Technological Innovation, report prepared for the National Science Foundation, 1976, table 3-1.

Figure 19.
U.S. Patent Grants by Nationality of Inventor
1960-86

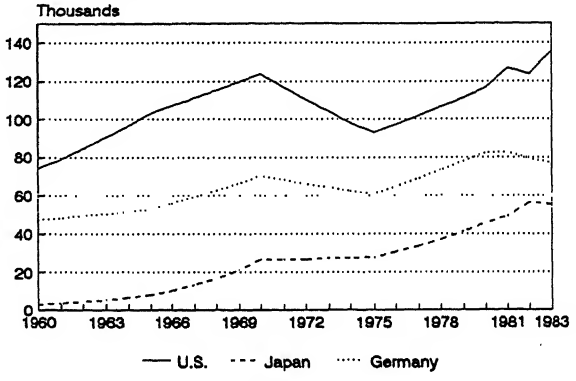


SOURCES: National Science Board, Science Indicators - 1985, (Washington, DC: National Science Foundation, 1986) p. 258; U..S. Department of Commerce, United States Patent Office, Office of Technology Assessment and Forecast, Technology Assessment and Forecast Report, (Washington, DC:U.S. Government Printing Office, 1973).

Not only has the domestic share of U.S. patents declined; patents to U.S. nationals have fallen sharply in absolute numbers since 1971. In a recent assessment, OTA considered possible reasons for this decline, considering that R&D spending has risen steadily.[43] Was the R&D process ineffective in getting results, or had U.S. firms decided deliberately not to seek patent protection? The analysis found evidence that the first possibility is more likely. In a recent survey, 100 U.S. firms reported that they sought to patent a greater percentage of developments in the period 1980-82 than in 1965-69.[44] If the propensity to patent is greater, and spending is higher, then it appears that spending has become less effective. Moreover, the National Science Foundation reports that, in thousands of influential journals throughout the world, research publications by American authors in the fields of engineering and technology fell steadily from 42 percent of the total in 1973 to 38 percent in 1982.[45]

Patenting in OECD countries by residents of other countries shows a brighter picture for the United States (figure 20). External patenting, as mentioned above, is a good indicator of the value companies place on their new technical developments since the expense and bother of applying in a foreign country tends to weed out trivial innovations. In OECD countries, U.S. nationals are the undisputed leaders in external patenting; they even had something of a surge in 1983 while Japanese applications dropped slightly. The Germans, despite recent declines, are still a strong second. Whether the U.S. surge in 1983 represented a one-time backlog or a real trend can only be proven when data for later years become available. The Japanese record remains impressive. Starting with about 3,000 applications in 1960, the Japanese advanced to more than 55,000 in 1983.

Figure 20.
External Patent Application By Nationality of Applicant



SOURCE: Organization for Economic Cooperation and Development, Science and Technology Indicators II: R&D, Inventiveness and Competitiveness (Paris: OECD, 1986), tables 24 and 26.

The main failing of patents as a measure of technological advance is that most patents are not commercialized; even external patents may or may not lead to commercial development. Productivity, another commonly used indicator, does not have this defect, since technology must be put to use in industry before it can contribute to a rise in productivity. Although productivity is but one factor in competitiveness, it is an important one. The U.S. record in improving manufacturing productivity is, all-in-all, not a bad one compared to Europe, especially in recent years; in the 1980s, our productivity

43 U.S. Congress, Office of Technology Assessment (1987), op. cit., p. 200.
44 Id., citing E. Mansfield, "Studies of Tax Policy, Innovation, and Patents: A Final Report," report to the National Science Foundation, October 1985, p. 6.
45 National Science Foundation, op. cit., p. 38.

growth rates have been as good or better than those of most of the big European countries. But Japan continues to beat all the advanced countries in productivity growth. That story is told below.

The core question, however, is whether American manufacturers are falling behind in the practical application of technology—using it to produce high quality goods at affordable cost. There are no aggregate data that really answer this question. The best way to approach it is to analyze firms and industries, case by case, to see how much and how well technology is contributing to U.S. competitiveness. OTA is doing that for the full assessment of Technology, Innovation, and U.S. Trade, of which this report is an interim product. A number of such case studies have already been done, by OTA and others. It is fair to say from the work already completed that the reputation of U.S.-made goods for quality and reliability has suffered in recent years and that American manufacturing methods are no longer the paradigm for the world.

One of the best examples of such work is Jaikumar's study of flexible manufacturing systems (FMS) in the United States and Japan.[46] A flexible manufacturing system is a production unit which is designed to manufacture different kinds of parts (for example, transmission cases or clutch housings for trucks and farm machinery) in relatively small batches. The FMS is made up of semi-independent work stations (such as numerically controlled machining centers), connected by automated material handling systems (conveyor belts, robots) and controlled by computer. Jaikumar compared how Japanese and American firms used FMSs, and concluded that American firms had used the technology far less effectively than the Japanese. The American systems produced many fewer kinds of parts, took longer to develop, and performed less reliably. For example, U.S. firms typically took 2.5 to 3 years to develop FMSs, compared with 1.25 to 1.75 years in Japan; produced only 10 different kinds of parts compared with the Japanese average of 93; and produced an average of 88 units per day compared with 120 in Japan. In Jaikumar's words, "[r]ather than narrowing the competitive gap with Japan, the technology of automation is widening it further."[47]

Jaikumar attributed the relatively poor performance of FMS in the United States to manangement, not to differences in machine quality or performance, or in the complexity or size of parts produced. American managers tended to prevent workers from making changes to the system once it was operating, treating the flexible automated technology in much the same way that dedicated, hard-wired automated equipment is used for mass production, and losing both efficiency and flexibility in the process. "If it ain't broke, don't fix it," was the attitude common among American managers.[48] Having spent much more time than the Japanese getting their FMSs up and running, American managers tried to nail down a standard operating procedure and stick to it. Japanese managers, on the other hand, were willing to continue tinkering and changing and improving their FMS installations. This constant emphasis on incremental redesign and improvement is in fact widely cited as a

46 Ramchandran Jaikumar, "Postindustrial Manufacturing," Harvard Business Review, Nov-Dec, 1986.
47 Ibid., p. 69.
48 Ibid., p. 71.

strength throughout Japanese industry, and a major factor behind the rapid improvement of Japanese productivity in manufacturing.[49]

Japanese firms emphasize process technology more than American firms. In a study of industrial innovation in 50 Japanese and 75 American firms, Mansfield found that the U.S. firms devoted about two-thirds of their R&D resources to improvement in product technology and one-third to improved process technology. The proportions were reversed for the Japanese firms. Mansfield also found that Japanese firms spend twice as much as their U.S. counterparts on tooling and manufacturing equipment and facilities for new products, and half as much on manufacturing and marketing start-up.[50]

While the Japanese have taken pains to master process technology, they have not neglected product development. Many new Japanese products were indeed based on American or European innovations, but the incremental adaptations made by Japanese firms often culminated in a product essentially different from the original innovation. The development of the videocassette recorder has become a classic example of how continual incremental refinement of someone else's basic invention, combined with heavy emphasis on manufacturing process development, enabled Japanese firms to come up with a product that was wholly new.[51] Moreover, the Japanese emphasis on excellence in process technology has shown up in a stream of production-related innovations that American producers in a variety of industries are eager to adopt, such as design for manufacturability, just-in-time inventory control, and statistical quality control. It should be noted that many of the Japanese strengths in production organization were first formulated by American efficiency experts like W. Edwards Deming and J.M. Juran, although it was in Japanese, not American, factories that they were applied with the most diligence.

One of the factors that helps explain the relatively poor American showing in manufacturing performance and technology is the link between production and research/development/design. Constant flows of people, information, and ideas between research and production is characteristic of Japanese firms.[52] In American firms, the processes of research (or design) and production are more often sequential, with the results of developmental work handed over to a different set of people for management of production. There is much less interaction between the designers of the product and the production managers. Japanese auto companies, for example, require just 43 months to take a model from the initial concept to full production; U.S. auto companies require 63 months to do the same.[53] What accounts for this 20-month lead, which can be crucial in adapting to market trends? Not

49 See, for example, Christopher Freeman, Technology Policy and Economic Performance: Lessons from Japan, University of Sussex, Science Policy Research Unit (London: Pinter Publishers, 1987), and A. Altshuler, M. Anderson, D. Jones, D. Roos, and J. Womack, The Future of the Automobile: The Report of MIT's International Automobile Program (Cambridge, MA: MIT Press, 1985).

50 Edwin Mansfield, "The Speed and Cost of Industrial Innovation in Japan and the United States: External vs. Internal Technology," mimeo, n.d.

51 See, for example, James Lardner, Fast Forward: Hollywood, the Japanese, and the VCR Wars, (New York: W. W. Norton & Company, 1987), and M.B.W. Graham, RCA and the VideoDisc: The Business of Research (Cambridge.: Cambridge University Press, 1986).

52 See, for example, U.S. Congress, Office of Technology Assessment, Strategies for Commercialization of High-Temperature Superconductivity, (Washington, DC: U.S. Government Printing Office, forthcoming); and Altshuler, et. al, op. cit.

53 Kim B. Clark and Takahiro Fujimoto, "Overlapping Problem Solving in Product Development," Harvard Business School Working Paper 87-048, March 1987.

from spending more: Japanese automakers use only about half as many engineering hours to complete a comparable project ("clean sheet" design of a new automobile and its production) as American automakers.[54] Clark and his colleagues concluded that the Japanese automakers' design processes are more efficient because they give a single "heavy manager" authority over the whole project; the people doing research, development and design are in constant communication with the people responsible for manufacture; conflicts are aired and settled early; product and process design are treated as simultaneous rather than sequential activities.

There are other Japanese strengths. Among those most often cited are greater attention to product quality and reliability, consensus building, and emphasis on long-term market share rather than short term profit. All are difficult to quantify, but firsthand observations, case studies, and the remarkable record of Japanese industrialization and adaptation in the postwar period support the basic point: Japanese manufacturers have moved into a commanding position in many industries and have surpassed U.S. rivals in many important markets, by developing and applying technology.[55]

While the record of technology development and application is mixed in different European countries and industries, there are also European examples of aggressive use of new technology to create a competitive advantage. One of the best known is textile industry machinery. Nearly all new weaving machines in American textile mills come from Europe (West Germany and Switzerland) or Japan. Unlike American suppliers, European manufacturers have introduced a new generation of equipment every couple of years. The new equipment is often programmable, can weave a variety of widths, and is faster and quieter than the best American weaving machines. Little wonder, then, that import penetration in textile machinery has increased from 7 percent of the U.S. market in 1960 to nearly 58 percent in 1986. Import penetration in weaving machinery was nearly 85 percent.[56]

The improvement in Japanese and other foreign producers' manufacturing efficiency, quality and performance has elicited a number of responses from American firms. Some responses have been helpful, and others have not. Overall, however, the responses made by U.S. manufacturers have not stabilized or improved America's position in world manufacturing.

54 Kim B. Clark, W. Bruce Chew, and Takahiro Fujimoto, "Product Development in the World Auto Industry: Strategy, Organization and Performance," paper presented to the Brookings Institution Microeconomics Conference, December 3, 1987.

55 We should not attribute too much of the Japanese record to this one set of factors, however. The Japanese home market is and has been much less pervious to imports, particularly in sectors targeted for development, than the American market, despite such widely-cited examples of growing American protectionism as the Multifiber Arrangement and Voluntary Restraint Agreements on Japanese auto imports. This subject—how foreign governments use trade and industrial policies to promote industrial development and manage competition from American and other developed-country products—is taken up in the full assessment, Technology, Innovation and U.S. Trade.

56 U.S. International Trade Commission, U.S. Global Competitiveness: The U.S. Textile Mill Industry, Report to the Committee on Finance, U.S. Senate, USITC Publication 2048, December 1987.

U.S. Manufacturing Performance

> This war—and it is a war—is being fought not with dollars, or oil or steel, or even with modern machines. It is being fought with creative imagination and organizational talent.

This admiring, if slightly defiant, description of a powerful foreign economic challenger is not an American's view of the Japanese competition in the late 1980s. It is a Frenchman's view of America in 1969.[57]

Twenty years later, this description of American industry as all-conquering has come to sound quaintly out of date. American pre-eminence in a great many manufacturing industries is gone. Take consumer electronics. Only one major U.S.-owned company is still making color TV sets, and most of its production takes place in Mexico; no American-owned company makes video cassette recorders or compact disc players. Mass production of automobiles was invented in the United States, but others (especially the Japanese) are now leaders in the technology and management of auto manufacture. Despite the U.S.-Japanese agreement restricting Japanese imports and despite the rise of the yen, 21 percent of the passenger cars sold in the United States in 1987 were Japanese-made (another 6 percent were made by Japanese companies in North America); another 9 percent were imports from other foreign countries.[58] In semiconductors, another native born American product and industry, U.S. companies are still strong, especially in microprocessors and advanced, custom designed chips. Yet, overall, U.S. companies have continually lost market share to Japanese competitors since the late 1970s. By 1987, they had almost ceded dynamic random access memory devices (DRAMs)—a large market segment that has been both cash cow and technology driver for the industry—to the Japanese. In all of these industries, trouble started before the rise of the dollar.

Against the evidence of a decline, some have argued that U.S. manufacturing is faring quite well, that productivity growth has been strong in the 1980s, and that the high dollar—not poor performance by manufacturing—is responsible for the massive manufacturing trade deficits of the decade. The prescription that usually follows from this argument is to do nothing in trade or industrial policy to support U.S. manufacturing. One part of the argument is the statement that manufacturing output, measured in constant dollars, has not declined as a share of gross national product, and that if it eventually does, that alone is not an "omen of decay or loss of competitiveness."[59] Instead, it may simply reflect a natural evolution to a different pattern of demand in a maturing economy, and to the successful economic development of our trading partners.

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57 Jean-Jacques Servan-Schreiber, The American Challenge (New York: Atheneum, 1969), p. xiii.

58 The remaining 64 percent were made in the United States and Canada. Production in both countries is considered "traditional North American" because of the U.S.-Canadian agreement establishing free trade in motor vehicles and parts.

59 Molly McUsic, "U.S. Manufacturing: Any Cause for Alarm?" New England Economic Review, January/February 1987. For other examples of this point of view, see Robert Z. Lawrence, Can America Compete? (Washington, DC: The Brookings Institution, 1984); Office of the U.S. Trade Representative, Annual Report of the President of the United States on the Trade Agreements Program, 1985, p. 20.

This argument does not really stand up to scrutiny. The United States is not and gives no sign of becoming a post-industrial economy. But because the question of manufacturing share is closely linked with policy, it is worth examining.

The Share of Manufacturing in the U.S. Economy

Though the record is not entirely clear, there is evidence that the share of manufacturing in gross national product (GNP) is falling. And while it is falling (or at best staying even), the demand for manufactured goods by American consumers, businesses, and government is rising.

In current dollars, the share of manufacturing in GNP fell from 29 percent in 1960 to just under 20 percent in 1986, and the rate of decline has been faster since 1979 than formerly (figure 21). However, this current dollar measure has the defect that it does not take rising productivity into account. Manufacturing has performed better than the economy as whole in raising productivity, and some of that productivity growth has been passed on to consumers in lower-than-average price increases. In fact, Commerce Department data on the constituents of GNP data show the share of manufacturing, in constant 1982 dollars, hovering quite steadily around 21 or 22 percent of total output since the late 1940s (figure 22). This series, prepared by the Department's Bureau of Economic Analysis (BEA), is the only regularly published official set of data on constant dollar shares of GNP. It is the basis for the statement that manufacturing's share of GNP has held steady for many years.

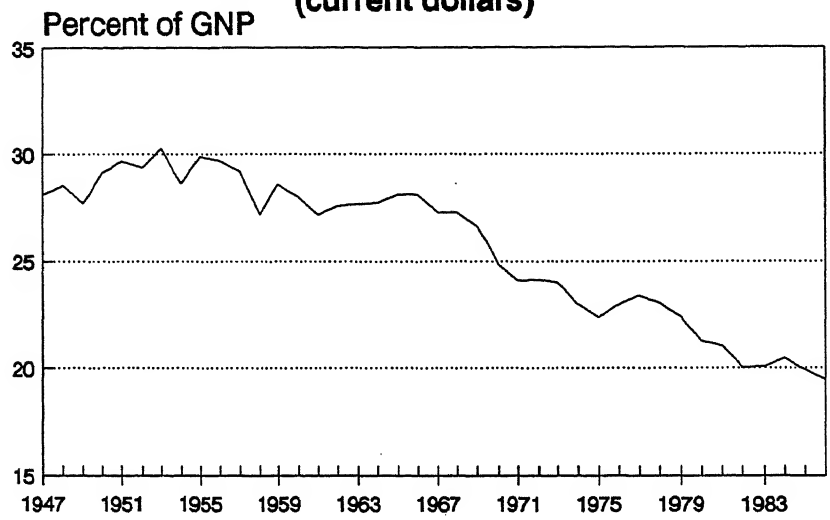
However, estimating the size of various parts of the economy in constant dollars is a difficult task; the uncertainties are great enough to cast doubt on the constant-share conclusion. In the BEA series based on constant 1982 dollars, one difficulty in particular looms large. That is the unique role assigned to the non-electrical machinery industry, which includes computers, in pulling up the whole manufacturing sector.

According to the BEA series, 15 of the 21 major manufacturing industries in the United States experienced a declining share of GNP from 1979 to 1986, while five stayed even or rose only moderately (see table 3) – not enough of a rise to offset the decline in the majority of industries. The only major industry showing a big increase in share was non-electrical machinery; and more than 100 percent of that industry's increase was due to the zooming sales, rapidly improving quality and productivity, and falling real price of computers. By the logic of the numbers, it would appear that computers, which contribute only 2 or 3 percent of manufacturing output, singlehandedly held up the share of the whole manufacturing sector.

Another difficulty is that the choice of base year for constant dollars greatly influences the results.[60] The more recent the base year chosen, the smaller appears the share of manufacturing in past years (see figure 22). For example, when 1958 is used as the base year, the share of manufacturing in real GNP for the year 1948 appears as 29.7 percent; on

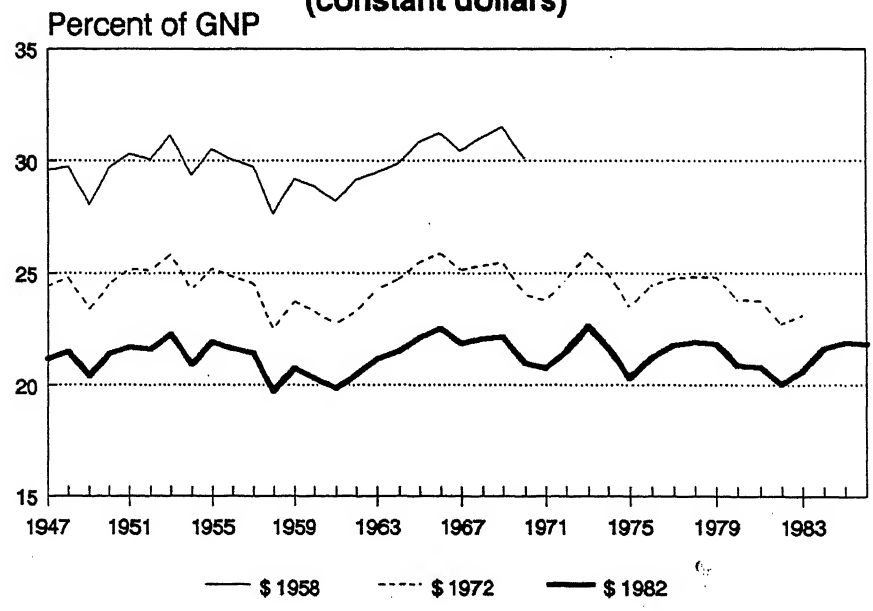
60 Nicholas S. Perna, "The Shift from Manufacturing to Services: A Concerned View", New England Economic Review, January/February 1987.

Figure 21
Manufacturing Share of U.S. Gross National Product
(current dollars)



SOURCE: U.S. Department of Commerce, Bureau of Economic Analysis, National Income and Product Accounts, electronic data, Table 6.1

Figure 22
Manufacturing Share of Gross National Product
(constant dollars)



SOURCE: U.S. Department of Commerce, Bureau of Economic Analysis, National Income and Product Accounts, electronic data, table 6.2

Table 3.—Manufacturing Share of Gross National Product, 1979–86 (1982 constant dollars)

	1979	1980	1981	1982	1983	1984	1985	1986	Change in share 1979–86	1986 deflator (1982 = 100)
Total GNP (constant 1982 dollars)	$3,192.4	$3,187.1	$3,248.8	$3,166.0	$3,279.1	$3,501.4	$3,607.5	$3,713.3	–	114.0
GNP implicit deflator 1982 = 100	78.6	85.7	94.0	100.0	103.9	107.7	111.2	114.0		
Manufacturing implicit deflator 1982 = 100	80.6	87.3	95.1	100.0	101.1	101.8	101.1	101.5		
	Percentage share of total GNP									
Manufacturing	21.84%	20.88%	20.81%	20.04%	20.60%	21.65%	21.91%	21.87%	0.2%	101.5%
Machinery, except electrical	2.62	2.65	2.73	2.53	2.65	3.28	3.81	4.06	54.7	57.0
Electric and electronic equipment	1.89	1.97	1.98	1.95	2.02	2.21	2.32	2.29	21.4	103.8
Instruments and related products	0.70	0.68	0.73	0.71	0.71	0.73	0.78	0.80	13.5	105.7
Other transportation equipment	1.17	1.20	1.02	1.02	1.18	1.22	1.26	1.31	12.1	112.0
Rubber and miscellaneous plastic products	0.63	0.59	0.64	0.61	0.66	0.69	0.70	0.70	11.8	104.2
Miscellaneous manufacturing industries	0.38	0.32	0.37	0.35	0.30	0.41	0.41	0.39	1.6	97.9
Paper and allied products	0.85	0.77	0.76	0.84	0.88	0.86	0.85	0.84	-0.7	111.8
Food and kindred products	1.72	1.78	1.79	1.94	1.89	1.74	1.74	1.69	-2.0	113.6
Printing and publishing	1.18	1.16	1.18	1.21	1.22	1.18	1.18	1.14	-3.3	128.6
Chemicals and allied products	1.74	1.57	1.65	1.75	1.82	1.71	1.56	1.60	-7.8	108.4
Furniture and fixtures	0.34	0.32	0.31	0.30	0.32	0.34	0.32	0.31	-9.3	117.5
Textile mill products	0.50	0.51	0.49	0.47	0.51	0.48	0.44	0.46	-9.8	109.5
Lumber and wood products	0.66	0.64	0.58	0.51	0.55	0.58	0.57	0.58	-11.6	114.8
Fabricated metal products	1.72	1.65	1.61	1.46	1.49	1.59	1.55	1.48	-14.2	103.8
Apparel and other textile products	0.61	0.63	0.62	0.60	0.60	0.58	0.54	0.53	-14.5	106.2
Stone, clay, and glass products	0.73	0.66	0.61	0.57	0.60	0.62	0.62	0.60	-18.1	114.0
Motor vehicles and equipment	1.50	1.06	1.04	0.93	1.17	1.37	1.32	1.20	-20.1	111.2
Petroleum and coal products	0.91	0.84	0.78	0.77	0.73	0.71	0.69	0.71	-21.5	147.3
Tobacco manufactures	0.31	0.30	0.30	0.28	0.27	0.25	0.20	0.19	-39.2	181.4
Primary metal industries	1.56	1.46	1.48	1.11	0.91	0.99	0.95	0.94	-39.6	99.4
Leather and leather products	0.13	0.13	0.14	0.13	0.12	0.11	0.10	0.08	-40.0	100.0
	Machinery, except electrical									
Output, billions of current dollars	$70.6	$76.9	$86.2	$80.0	$75.3	$85.4	$88.2	$85.9		
Deflated output, billions of $ 1982	83.8	84.6	88.6	80.0	86.9	114.8	137.5	150.8		
Implicit deflator 1982 = 100	84.2	90.9	97.3	100.0	86.7	74.4	64.1	57.0		
Manufacturing share (%) excluding machinery, except electrical	19.2	18.2	18.1	17.5	17.9	18.4	18.1	17.8		

SOURCE: Bureau of Economic Analysis, National Economic Product Accounts, electronic data, Tables 6.1, 6.2.

a 1972 base, the share in 1948 appears as 24.8 percent; with the 1982 base, the 1948 share shrinks to 21.5 percent—just about the same as the 1982 share, which was 21.8 percent. The difficulty with applying an updated constant dollar base to earlier years is that the new base contains new weights for the inputs to industries,[61] and these new weights do not represent the economy as it really was in earlier years. Perna, in discussing this problem, said: "The further one gets from the base period, the less representative it is of the economy's actual structure."[62]

In order to analyze the changing structure of the economy for its assessment *Technology and the American Economic Transition,* OTA independently prepared estimates of various parts of the economy in constant 1980 dollars for selected years.[63] The OTA estimates show manufacturing's share declining by 2.5 percentage points from 1972 to 1984, with an accelerated decline after 1977. The complications and uncertainties of constructing these constant dollar estimates are great; OTA's estimates have their share of flaws. The point is that constant dollar estimates are not graven in stone, but must be taken with a degree of caution.

Suppose it is true that manufacturing is fading as a contributor to the economy as a whole. The next question is: does it matter? It is not ordained that the share of manufacturing in GNP should remain constant. In fact, the current dollar figures show it declining gradually in the 1950s and 1960s, when American manufactured goods were still dominant in the world (however, the decline hastened in the 1970s and 1980s, as American products lost world market share). Moreover, agriculture is often held up as an example of a sector of the economy that grew greatly in output and productivity while declining from a 22 percent share of the national economy at the turn of the century to 2.2 percent in 1986.

A critical difference between manufacturing and agriculture is that the latter has continued to fulfill domestic demand (more precisely, to produce enough that imports are fully covered by exports, and sometimes to generate sizable trade surpluses as well). Over the years, Americans have devoted successively smaller shares of their total purchases to products of farms, forests, and fisheries, and more to other goods and services. The same is not true of manufactured goods. While per capita spending for services has grown greatly in the past 40 years (table 4), it was not at the expense of demand for manufactured products. While consumers spent smaller shares of their growing incomes on food and fuel, they spent more on items such as cars, television sets, and sports gear. Altogether, American consumers, businesses, and government increased their share of spending on manufactured goods other than food and fuel items from 23.4 percent of all their purchases in 1948 to 30.7 percent in 1986. Clearly, the U.S. economy is not passing into a post-industrial state in which demand for manufactured goods is giving way to demand for services.

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61 The weights are used to construct price deflators, which are the basis for constant dollar estimates of GNP and its constituents.

62 Id. For another study that questions BEA's methods for developing the constant-dollar series, and concludes that manufacturing has declined as a share of GNP, see Lawrence R. Mishel, Manufacturing Numbers: How Inaccurate Statistics Conceal U.S. Industrial Decline (Washington, DC: Economic Policy Institute, 1988).

63 U.S. Congress, Office of Technology Assessment, Technology and the American Economic Transition: Choices for the Future OTA-TET-283 (Washington, DC: U.S. Government Printing Office, May 1988).

Table 4.—Real per Capita Spending on Goods and Services (1960–86)

	Per capita spending in 1982 dollars					Percent of real apparent consumption				
	1948	1960	1973	1979	1986	1948	1960	1973	1979	1986
Apparent consumption	$7,432	$9,233	$13,099	$14,166	$15,973	100.0%	100.0%	100.0%	100.0%	100.0%
Gross national product	7,563	9,211	12,950	14,182	15,370	101.8	99.8	98.9	100.1	96.2
Goods purchases	3,437	3,966	5,613	6,200	7,250	46.2	43.0	42.9	43.8	45.4
Consumer manufactures, except food and fuel	1,038	1,253	2,076	2,320	2,873	14.0	13.6	15.9	16.4	18.0
Producers' durable equipment	525	461	942	1,150	1,298	7.1	5.0	7.2	8.1	8.1
Government goods purchases	181	400	408	461	733	2.4	4.3	3.1	3.3	4.6
Consumer food and fuel purchases	1,693	1,851	2,187	2,269	2,346	22.8	20.1	16.7	16.0	14.7
Service purchases	2,961	3,956	5,629	6,287	7,041	39.8	42.9	43.0	44.4	44.1
Consumer services	1,920	2,455	3,710	4,315	4,925	25.8	26.6	28.3	30.5	30.8
Government services	1,042	1,501	1,919	1,972	2,116	14.0	16.3	14.6	13.9	13.2

NOTE: Apparent consumption equals gross national product less exports plus imports.

SOURCE: U.S. Department of Commerce, Bureau of Economic Analysis, National Income and Product Accounts, electronic data, consumer goods and services purchases from Table 2.3; government goods and services spending from Table 3.8B; producers' durable equipment spending from Table 5.7.

Until about 1970, U.S. production of manufactured goods generally kept pace with consumption, or stayed ahead; but then output began to dip below consumption, as shown in the recurring manufacturing trade deficits of the decade. In the 1980s, of course, manufacturing output fell far short of consumption, creating the mounting manufacturing trade deficits. Foreign suppliers have filled the ever-widening gap between production and consumption of manufactured goods in the United States in the 1980s.

Manufacturing Employment and Wages

Other measures that may tell us something about the performance of U.S. manufacturing are the number of people working in it and what they get paid. Jobs in manufacturing have declined in the past decade, not just in relative terms, but in absolute numbers. Real wages of production workers in manufacturing (adjusted for inflation) have also dropped, by about 6 percent over the past 10 years. Real compensation per manufacturing worker, including employer-provided benefits, has stayed almost flat—in striking contrast to Japan and major European countries, where manufacturing compensation rose about 20 percent in the same period.[64]

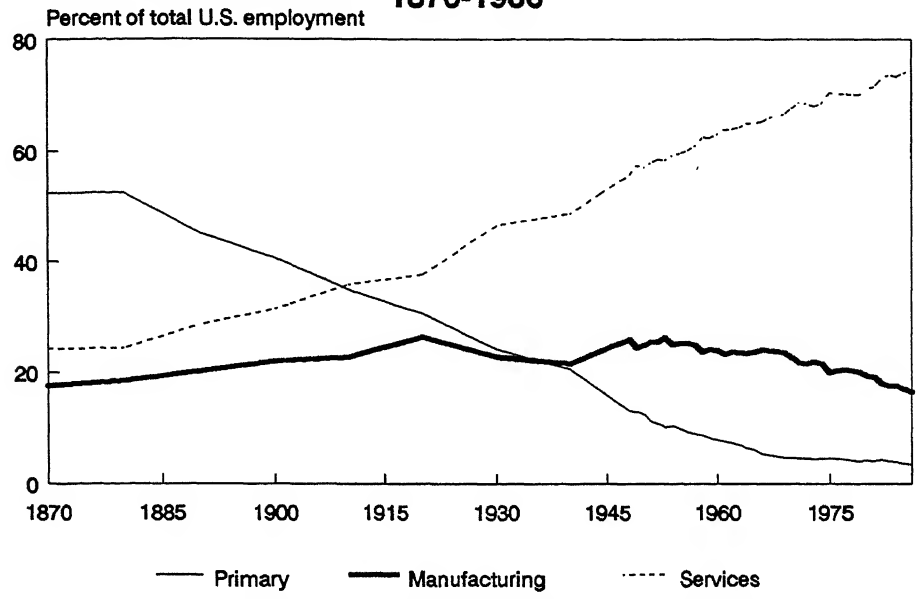
The decline in manufacturing jobs has been hard on millions of displaced workers and their families and scores of communities, but it does not necessarily signify weakness in the manufacturing part of the economy. Since the nineteenth century, and throughout the period of American industrial dominance, the share of employment in services has been larger, and has grown faster, than in manufacturing (figure 23). As the output of manufactured goods grew, employment rose less because of improving labor productivity.

While the *share* of employment in U.S. manufacturing started a gradual decline in the 1950s, the absolute number of manufacturing jobs kept growing until 1979, when manufacturing employment peaked at 21 million. In 1986, it averaged 19.1 million. With the strong expansion of exports and manufacturing output toward the end of 1987, employment recovered to 19.4 million—still 1.6 million below the peak.

An absolute loss of manufacturing jobs is not necessarily a sign of weakness either. Some of the shrinkage in employment was certainly due to rising productivity. Some was also certainly due to the enormous growth in net imports of manufactured goods over the same period. And much of it was due to a combination of the two factors, in which actions to improve productivity—automation, for example, or closure of older, less efficient plants—were forced by foreign competition. If demand for a product is growing fast enough, then imports, productivity, and employment can rise simultaneously. If not, rising net imports are likely to cost jobs. For example, employment in three traditional industries—steel, textiles,

64 U.S. Department of Labor, Bureau of Labor Statistics. The figure for wages is the real hourly wage for production workers, who make up about two-thirds of manufacturing employment. The figure for compensation is real weekly compensation for all persons employed in manufacturing, including wage and salary earners, the self-employed, and unpaid family workers, in the United States, and for all employees in other countries. The Consumer Price Index was used as the basis for calculating real wages and real compensation.

Figure 23
Distribution of U.S. Employment, by Sector
1870-1986



SOURCE:
U.S. Department of Commerce, Bureau of the Census, Historical Statistics of the United States, (Washington, DC: 1975) p. 137, series D127-141

and motor vehicles—dropped by 600,000 from 1979 to 1986. In each of these industries, productivity improved and imports rose; at the same time, demand for the industries' products either declined or grew slowly.

One study, following the ripple effects of imports and exports through the economy by means of an input-output model, concluded that the United States gains 7.5 percent more jobs from a given amount of exports than it loses from the same amount of imports.[65] Every $10 billion of exports generates 193,000 jobs, the study found, while 179,000 jobs are lost with $10 billion of imports. However, the trade deficits have been so big in recent years that job losses due to imports have swamped the job-creating effect of exports. In 1987, for example, exports of goods and services amounted to $428 billion while imports were $547 billion. The deficit of $119 billion spelled a net loss of 1.5 million jobs, according to the analysis.

It has been suggested that the loss of manufacturing jobs in recent years may be at least partly illusory, because it simply reflects the trend in many manufacturing companies to contract out services that they formerly paid their own employees to perform. For example, if General Motors lays off engineers and contracts with an engineering design firm to do the work once done in-house, that shows up in national employment data as a loss of jobs in manufacturing and a gain in the engineering and architectural services category. In the same way, if firms un-

65 Richard S. Belous and Andrew W. Wyckoff, "Trade Has Job Winners, Too," Across the Board, September 1987. The authors used the OTA input-output model for this study.

bundle legal, accounting, auditing, janitorial, or clerical activities, then the employment figures would show a shift from manufacturing to services. A recent analysis, done by a U.S. Department of Labor economist, concludes that unbundling has been a very small factor in the growth of employment in producer services in the last decade.[66] Within manufacturing firms, the proportion of workers in managerial, professional, and technical occupations has actually risen (and the rise is not accounted for by a changing mix of manufacturing industries). While the proportion of clerical and service workers in manufacturing has dropped slightly, these occupations are not very significant in the growth of employment in producer services. Thus, unbundling is not happening industrywide, though it may well be happening in some individual firms. Firms may be buying more services from outside, but not at the expense of already existing jobs in the manufacturing sector.

It is fair to conclude that the job losses in manufacturing are real, not illusory. And though it may be hard to calculate the exact number of jobs lost to import competition, the number is probably large—above 1 million at the least.[67]

It also seems evident that import competition has been a powerful factor holding down the wages of manufacturing workers. Until the 1970s, wages of manufacturing workers, like wages of American workers generally, rose strongly and steadily. Since then, manufacturing workers have made few lasting gains, and the real wages of production workers (i.e., blue collar workers on the shop floor) had not regained their 1978 peak a decade later. While manufacturing workers in the other advanced industrial nations enjoyed strong growth in real compensation (wages plus benefits) from 1977 to 1986—growth that ranged from 14 percent in Italy, to 19 percent in Japan and Germany, to as much as 24 percent in Britain—Americans employed in manufacturing gained less than 2 percent.

What happened to manufacturing wages has happened to real wages and salaries of all Americans: the long-term, consistent growth of the postwar period came to a halt in 1973, and there has been an unsteady but overall decline since 1978.[68] Part of this change may have been due to demographics; the surge of young people from the baby boom and the increased participation of women in the labor force probably held down wage growth in the 1970s. However, the rate of growth in the work force has been falling since 1978, and is now back to earlier norms. Since 1978, a combination of factors has restrained real wage growth: first, inflation, and then the deep recession of 1981-83, the decline of labor unions and, not least, the loss of manufacturing jobs to foreign competition and the threat of further losses.

66 John Tschetter, "Producer Services Industries: Why Are They Growing So Rapidly?" Monthly Labor Review, December 1987.

67 Some analysts have argued that the loss of U.S. manufacturing jobs since 1979 simply matches improvement in manufacturing productivity, and draw the conclusion that imports had no effect on job loss. However, rising imports of manufactured goods during the 1980s almost certainly replaced some domestic production of these goods—and the jobs that would have been devoted to producing them. In addition, as discussed in a later section, the official figures may overstate the growth in manufacturing productivity in the 1980s.

68 Weekly earnings of full-time wage and salary earners declined 3 percent from their 1978 peak to 1987; hourly earnings of production and nonsupervisory workers on private nonagricultural payrolls declined 8 percent from 1978 to 1987. Earnings figures are from U.S. Department of Labor, Bureau of Labor Statistics, Employment and Earnings, tables A-73 (published quarterly) and B-1 (published monthly). Real earnings are figured on the basis of the Consumer Price Index for Urban Consumers (CPI-U), 1982=100.

Productivity Growth: International Comparisons

Another measure of how U.S. manufacturing is doing in comparison with other nations is trends in productivity. The bare figures suggest that, over the past quarter of a century, the United States did not measure up to other nations in raising labor productivity in manufacturing.[69] The U.S. growth rate was less than 3 percent per year, on average, from 1960 to 1986; this compares with nearly 8 percent for Japan, about 5 percent for France, Italy, and Germany, and over 3 percent for Great Britain and Canada (table 5).

Behind these 26-year averages lies a more complex story. Since 1979, the American record has been about as good as Europe's—better than some major countries and not far behind the leaders. But, as noted earlier, America's number one trade competitor, Japan, has continued to excel, achieving higher growth than any other industrialized country in the 1980s, with an average of 5.6 percent growth per year from 1979 to 1986 compared to 3.5 percent for the United States. Another distinction for Japan is that its productivity growth, more than that of any other advanced country, continues to be linked with rising output and employment.

Faster productivity growth in other industrialized countries was in part a catchup phenomenon. From 1960 to 1973, U.S. manufacturing productivity rose at the respectable rate of 3.2 percent per year; but this rate was bettered by nearly all European countries, most of which were repairing war damage and investing in new industrial equipment. Japan, starting from a lower prewar base and suffering more war destruction than most European nations, was advancing even faster, at the remarkable average annual rate of 10.3 percent.[70]

From 1973 to 1979, productivity growth slowed to some degree in all the industrialized countries but (except for Britain's dismal record) the U.S. growth rate dropped to

Table 5.—Annual Percent Changes in Manufacturing Productivity, Seven Countries (1960-86)

Year	United States	Canada	Japan	France	Germany	Italy	United Kingdom
Output per hour:							
1960-86	2.8	3.3	7.9	5.2	4.6	5.7	3.6
1960-73	3.2	4.5	10.3	6.5	5.8	7.5	4.2
1973-79	1.4	2.1	5.5	4.9	4.3	3.3	1.2
1979-86	3.5	2.3	5.6	3.1	2.7	4.3	4.5

NOTE: Rates of change based on the compound rate method.

SOURCE: Arthur Neef and James Thomas, "Productivity in Manufacturing at Home and Abroad," *Monthly Labor Review*, December 1987; U.S. Department of Labor, Bureau of Labor Statistics, *Monthly Labor Review*, December 1987, Table 47.

69 Productivity of other factors of production besides labor, especially capital, is also very important to good manufacturing performance. However, international comparisons are usually limited to labor productivity since data on multifactor productivity are fragmentary.

70 A number of economic historians have discussed the political and social conditions that made it possible for many nations—especially Germany and Japan—to rebuild rapidly and catch up after World War II; see, for example, Moses Abramovitz, "Catching Up, Forging Ahead, and Falling Behind," Journal of Economic History, June 1986, XLVI (2), pp. 385-406; Mancur Olson, The Rise and Fall of Nations: Economic Growth, Stagflation and Social Rigidities (New Haven, CT: Yale University Press, 1982).

much the lowest of any major country. The U.S. manufacturing productivity growth rate has apparently recovered in the 1980s, both in relation to this nation's own history and to the current experience of European countries. The caveat implied by "apparently"is this: growth rates in manufacturing productivity are based on the BEA (Commerce Department) constant-dollar figures for GNP. As discussed earlier, there are major difficulties in constructing such a series; in particular, since 1982, the real, constant-dollar share of the manufacturing sector in GNP may be overstated because the contribution of computer manufacture may be exaggerated. If this is so, then the rate of productivity growth in manufacturing in recent years is also overstated. Excluding non-electrical machinery (SIC 35, which includes computers), the growth rate for all other manufacturing was 2.2 percent per year for 1979 to 1986, compared to 3.5 percent when the non-electrical machinery segment is included. A realistic estimate for manufacturing productivity growth probably lies between the two figures.

Despite these statistical problems, the picture drawn from productivity growth figures over the past 26 years is reasonably consistent with common sense observations. European countries rebuilt in the 1960s and, except for Britain, continued to grow in the 1970s (although at a rather slower pace) while U.S. growth slowed drastically. In the 1980s, the United States has more or less kept pace with Europe (again except for Britain, which has recently posted the best growth rate among major European countries). On the evidence of the productivity figures, it seems possible that our deteriorating trade balances with Europe in the 1980s were due more to the high dollar than to subpar performance in manufacturing; indeed, the United States maintained a positive trade balance with Europe until 1983, and the balance with Europe was the first to improve as the U.S. trade deficit finally began to decline in 1988. This does not imply that U.S. manufacturing is equal to the Europeans in all sectors or products, but American producers do have areas of strength vis-a-vis the Europeans.

The Japanese challenge is different. Starting from a lower base, the Japanese improved much faster than everyone else until 1973. Relying almost entirely on imported oil to run its industries, Japan was even harder hit by the oil shocks of the 1970s than Europe, and certainly than the United States; yet Japan managed to stay on top in productivity growth throughout the 1970s, and has continued to improve in the 1980s at rates matched by no other advanced industrial country. Impressively, the Japanese have continually raised output and employment while improving productivity. From 1979 to 1986, Japan's manufacturing output grew 60 percent, and employment in manufacturing nearly 10 percent, despite a slight drop in 1986 caused by the rising yen (table 6).[71]

It is quite another story for the European leaders in productivity growth. Britain, which boasted a 4.4 percent annual productivity growth rate from 1979 to 1986, did it, at least in part, by drastic cutbacks in the manufacturing sector in the early 1980s.

71 Manufacturing employment in Japan declined from 1974 to 1979, following the oil shock; it regained the 1974 level in 1986. However, real compensation in manufacturing rose steadily every year, to a level 27 percent higher in 1986 than in 1973. Real compensation in U.S. manufacturing rose 7 percent during the same period, with nearly all the gain occurring before 1978.

Plants were closed, workers were laid off, and unemployment soared to 20 percent and above in the industrial North. Through 1982, Britain's manufacturing output declined sharply; it has since turned back up, showing a moderate overall loss for the 7 years of 4.4 percent. Manufacturing employment fell steadily with no recovery, for a loss of 27.5 percent. France, with a productivity growth rate of 3.1 percent per year, had a 2 percent cut in manufacturing output and lost 16 percent of manufacturing employment. Italy's large rise in productivity went along with a sharp drop in manufacturing employment. Germany and the United States were in the middle, with medium to good productivity growth, rising output, and moderately declining employment.

While jobs in U.S. manufacturing dropped by 10 percent from 1979 to 1986, real output rose over 16 percent (according to the BEA constant dollar series). At least some of the turnaround in American manufacturing productivity was due to shutdown of older, less efficient plants. With this restructuring came some massive worker displacement; an average of 2 million workers per year, half of them in manufacturing, lost jobs due to plant closures or production cutbacks from 1979 to 1985.[72] Steel is an extreme example. Jobs in basic steel numbered 570,000 in 1979 and by the end of 1987 were down to 280,000. The USX company, formerly U.S. Steel, contracted from over 100,000 employees in 1980 to fewer than 20,000 in 1987. But meanwhile, USX productivity improved from 10.8 manhours per ton of steel shipped in 1983 to 3.8 manhours in 1987.[73]

Table 6.—Index of Manufacturing Output and Employment, 1986; and Productivity Growth Rates, 1979-86

	1986		Annual average manufacturing productivity growth 1979-86
	Output (1979 = 100)*	Employment (1979 = 100)*	
United States	116.5	90.6	3.5
Canada	114.2	97.1	2.3
West Germany	105.8	92.1	3.1
France	97.8	84.4	2.7
Italy	112.2	82.5	4.3
Japan	159.9	109.5	5.6
United Kingdom	95.7	72.5	4.5

*Adapted from Labor Department data published on a 1977 = 100 basis.

SOURCE: Arthur Neef and James Thomas, "Productivity in Manufacturing at Home and Abroad," *Monthly Labor Review*, December 1987; U.S. Department of Labor, Bureau of Labor Statistics, *Monthly Labor Review*, December 1987, Table 47.

In the last half of 1987, as exports finally began to rise briskly in response to the low dollar, manufacturing employment climbed a little (but still remained 8 percent below the 1979 peak) while output grew to 30 percent above the 1979 level. During the expansion, productivity growth held up; the growth rate was 3.7 percent in 1986 and 3.3 percent in 1987. To some degree, this simply reflected greater use of plant capacity, which generally has the effect of raising productivity. But there are some signs that it also reflects more fundamental changes—investment in productive new equipment, more efficient organization of work, and better use of people.

A measure for comparing levels of labor productivity from one country to another (as distinguished from *growth rates*) is gross

72 These figures are from two surveys of worker displacement, designed and analyzed by the Bureau of Labor Statistics, U.S. Department of Labor, and conducted by the Bureau of the Census, U.S. Department of Commerce, in January 1984 and January 1986.

73 David Ignatius, "What's Left of Big Steel?" The Washington Post, Mar. 20, 1988, p. C1.

domestic product per employee. This economy-wide measure includes private services and government activities as well as manufacturing. By this measure, the United States was still ahead of most other advanced nations in 1986. Several European countries stood at 80 to 90 percent of the U.S. level, and Japan had reached 69 percent.[74] However, the rate of productivity growth in the whole U.S. economy has recovered only slightly from the doldrums of the 1970s. Other major industrialized nations are now improving at much faster rates, Japan the fastest of all (see table 7).

It is a common observation that although agriculture, many kinds of services, and some manufactures are not highly productive in Japan, the Japanese have put prodigious effort into raising productivity in industries such as steel, autos, and electronics that have been central to their export-led growth strategy. It would be helpful, in comparing productivity levels in the United States with Japan, to break out manufacturing, by industry, from the rest of the economy. However, various international comparisons of levels of manufacturing productivity have come to quite inconsistent conclusions; in some, Japanese manufacturing productivity is shown as barely 70 percent of the U.S. level, while in others it is over 90 percent for all manufacturing and well above 100 percent for certain industries.[75]

Several case studies of individual industries have found that Japan has not only caught up with the United States in productivity, but has forged ahead. For example, the International Motor Vehicle Program found that in the mid-1980s it took, on average, 19.1 hours to build a car in Japanese assembly plants

Table 7.—Average Annual Changes in Real Gross Domestic Product per Employed Person, 1960-86

Year	United States	Canada	Japan	France	Germany	Italy	United Kingdom
1960-86	1.2%	1.9%	5.5%	3.6%	3.1%	3.7%	2.2%
1960-73	1.9	2.6	8.2	4.9	4.1	5.8	2.9
1973-79	0.0	1.3	2.9	2.7	2.9	1.7	1.3
1979-86	0.8	1.0	2.8	1.9	1.6	1.6	1.7

SOURCE: U.S. Department of Labor, Bureau of Labor Statistics, Office of Productivity and Technology, unpublished data, mimeo, August 1987.

74 These cross country comparisons are based on purchasing power parity (PPP) exchange rates, which show what it costs in one unit of foreign currencies to buy goods and services equivalent to what a dollar will buy. At market exchange rates, rather than PPP exchange rates, Japan's GDP per employee reached 90 percent of the U.S. level in 1986. The market exchange rate for 1986 was 168.5 yen to the dollar; the PPP rate was 220 yen to the dollar. Another measure of economy-wide productivity is GDP per hour worked. Since Japanese workers put in more hours per year than U.S. or European workers, this measure shows Japan at only 58 percent of the U.S. level in 1986, using PPP exchange rates, and 69 percent using market rates.

75 See, for example, Elliot S. Grossman and George E. Sadler, Comparative Productivity Dynamics: Japan and the United States (Houston, TX: American Productivity Center, 1982); George E. Sadler, Update: International Productivity Comparisons (Houston, TX: American Productivity Center, 1986); Elliot S. Grossman, Pace University "Productivity and International Competition: United States and Japanese Industries," paper prepared for conference on Interindustry Differences in Productivity Growth, American Enterprise Institute, Washington, DC, October 1984; Martin Baily and Alok Chakrabarti, Innovation and the Productivity Crisis (Washington, DC: The Brookings Institution, 1988); Japan Productivity Center, Productivity Research Institute, International Comparisons of Labor Productivity (Tokyo: Japan Productivity Center, 1988); Molly McUsic, op. cit.; and calculations based on data in Organization for Economic Cooperation and Development, Industrial Structure Statistics, 1985 (Paris: OECD, 1987).

and 19.5 hours in Japanese-managed plants in America. In American-managed plants the average time for assembly was 26.5 hours. The quality of the Japanese autos was better too, judging by the record of defects owners discovered in the first three months of use. The U.S. plants were improving, were generally more productive than European plants, and had about as good a record as the European car makers in freedom from defects; but the Japanese were getting better too.[76] For another example, Japanese productivity and quality is conceded to be superior in parts of the semiconductor industry, especially in the manufacture of 256K dynamic random access memory chips.

The solid conclusion that can be drawn from available data is that Japan remains the leader in productivity growth. It is normal and expected that countries developing from a rural past to an industrialized future should show high rates of productivity growth; witness Japan in the 1950s and 1960s and Korea now. What Japan has accomplished in the past decade is to keep on raising productivity at a rapid rate, *after* becoming world class in many industries, raising output, employment, and wages through times of a rising yen as well as a falling yen.

One element supporting Japan's progress is a high rate of investment in manufacturing. As figure 24 shows, Japan consistently invested more in manufacturing, per dollar or yen of manufacturing output, than the United States did, from 1973 to 1985.[77] As for capital invested each year per manufacturing worker, the Japanese investment (expressed in U.S. dollars) climbed rapidly from 1978 on, and by 1985 was 11 percent above the U.S. level.[78] These figures do not tell the story for the whole economy. For example, taking services together with manufacturing, the Japanese rate of investment in machinery and equipment, per employee, was about on a par with the U.S. rate in 1985. If Japan's rate of capital investment is higher in manufacturing, the U.S. rate is almost certainly higher in many service industries. For example, optical scanners of bar codes and computerized systems for inventory control are now commonplace in American supermarkets and retail stores. Japan has poured most of its investment and management efforts into the manufacturing industries that its leaders see as critical for competing in world markets. Many services have been relatively neglected, though not all; certain services important to international trade, such as banking, do very well.[79]

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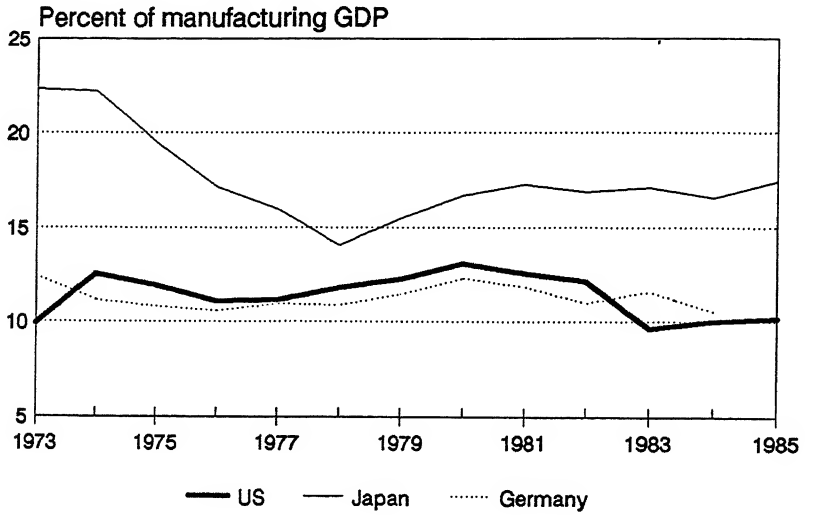
76 Information provided by the International Motor Vehicle Program, Center for Technology, Policy, and Industrial Development, Massachusetts Institute of Technology.

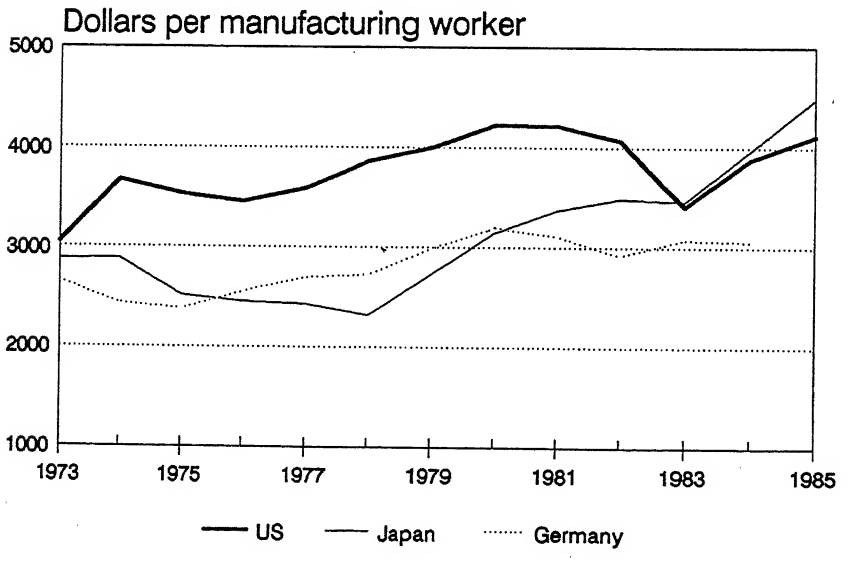
77 The source of this information is the Organization for Economic Cooperation and Development (see figure 24 for source details); 1985 is the latest year for which data are available. Investment in manufacturing means gross capital formation, including buildings and producers' durable equipment. Manufacturing output is the share of manufacturing in gross domestic product, that is value added in manufacturing.

78 How U.S. and Japanese investment per worker compare depends a great deal on what exchange rate is chosen. (This is not true of investment as a share of manufacturing output, which can be figured in each country's own currency.) The figures here are in U.S. dollars, based on 1985 prices and the 1985 purchasing-power-parity (PPP) exchange rate for fixed capital formation in machinery and equipment. PPP exchange rates are developed by the Organisation for Economic Cooperation and Development (OECD) to show what it costs to buy the same amount of goods and services in different currencies. The PPP exchange rate for machinery and equipment in 1985 was 246 yen to the dollar.

79 U.S. Congress, Office of Technology Assessment, International Competition in Services, (1987), op. cit., see especially chapter 3, "International Competition in Banking and Financial Services."

Figure 24
Gross Fixed Capital Formation in Manufacturing, 1973-85





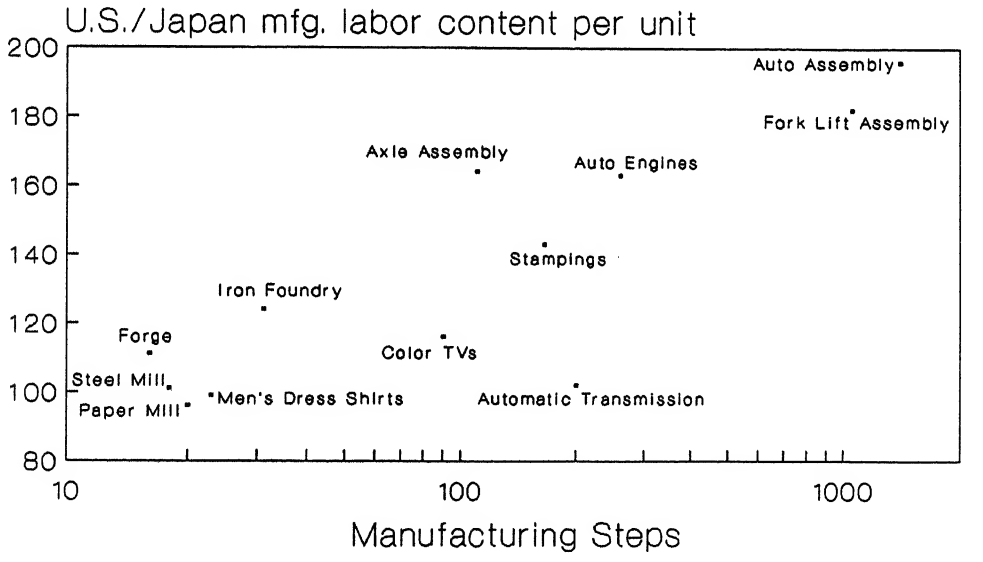
NOTE: Converted to U.S. dollars at 1985 Purchasing Power Parities for Machinery and Equipment Capital Formation.

SOURCE: Organization for Economic Cooperation and Development, Flows and Stocks of Fixed Capital, 1960-85, (Paris:OECD, 1987); OECD, National Accounts, Detailed Tables, 1960-85, Volume II, (Paris: OECD, 1987)

Large investment in equipment does not by itself assure either productivity growth or good performance in manufacturing; how work is organized and people used with the new equipment make a big difference. Here, the Japanese seem to excel. Managerial competence is an important source of productivity growth in Japan, especially in complex manufacturing where many steps are required and many operations must be coordinated. For example in automobile manufacture, assembly requires over 1,000 independent operations; a report of a few years ago found that Japanese auto assembly plants were twice as productive as in American plants.[80] In engine plants, with about 200 operations, Japanese labor productivity was 50 percent higher. In iron foundries, where only about 30 steps are needed, the Japanese advantage disappeared (see figure 25).

Since the turn of the century, America has been in first place in the most generally used economy-wide measure of productivity, GDP per employed person. If others, starting from a lower base, are to catch up and enjoy the same benefits Americans get from

Figure 25.
Manufacturing Productivity in Japan and the United States



NOTE: As the number of steps in manufacture increases, the ratio of total factory labor content per unit of output of U.S. factories increases relative to Japanese factories.

SOURCE: James Albegglen and George Stalks, Jr., Kaisha, Tha Japanese Corporation (New York: Basic Books, 1985)

80 James Abegglen and George Stalk, Jr., Kaisha: The Japanese Corporation (New York: Basic Books, 1985). U.S. assembly plants have since improved, according to the International Motor Vehicle Program of the Massachusetts Institute of Technology cited above. The Program's recent survey showed that the average Japanese assembly plant now has a 40 percent advantage in productivity over the average U.S. plant.

rising productivity – economic growth and rising standards of living – their growth rates must be higher, at least for a time. Indeed, it has been suggested that convergence of productivity levels among industrialized nations is all but inevitable, due to the diffusion of technical knowledge all over the world and to the application of that knowledge by those striving to catch up.[81] This idea contains some truth but it does not justify complacency. If U.S. productivity growth were to lag behind that of its trade competitors for long, the consequences would be serious. The example of Great Britain, the former world leader, is cautionary. The U.K. productivity growth rate averaged less than one percentage point below that of the United States from 1870 to 1950, but during that time the output per capita of the British economy dropped to 60 percent, and America eclipsed Britain in standard of living and industrial might.[82]

81 For an exposition of this point of view, see William J. Baumol. "Productivity Growth, Convergence, and Welfare: What the Long-Run Data Show," The American Economic Review, vol. 76, no. 5, December 1986.

82 Angus Maddison, "Growth and Slowdown in Advanced Capitalist Economies: Techniques of Quantitative Assessment," Journal of Economic Literature, vol. xxv, June 1987.

Why Manufacturing Matters

The evidence is substantial that U.S. performance in manufacturing has weakened, that several important American industries do not measure up to the competition, and that the trouble cannot all be laid at the door of the high dollar. The next question to ask is whether it matters. Does the Nation really need a strong manufacturing sector? Or has the time come to gradually cede production of goods to other countries while in this country manufacturing gives way, in a natural and desirable progression, to performance of services?

The answer, for now and the foreseeable future, is that there is no choice to made between manufacturing and services. The nation needs both. As we have seen, manufactured goods are indispensable for trade with other nations. It is also clear that America has not entered a post-industrial stage; the demand for manufactured goods by consumers, businesses, and government is greater than ever. Moreover, to speak of services as taking the place of manufacturing in the economy is to overlook the strong interdependence of the two kinds of activities and the blurring of distinctions between them. Many manufacturing industries could hardly exist without allied services; the manufacture of computers and design of software (often by an independent firm) are an obvious example. It works the other way as well. For instance, manufactured hardware makes it possible for hospitals to offer highly sophisticated radiology services such as magnetic resonance imaging and computerized tomography.

There are worrisome aspects to this interdependence. With the great rise in imports of manufactured goods in the 1980s, a large number of jobs were lost in manufacturing, and with them went some closely associated jobs in the service sector. OTA's analysis suggests that about 6.5 million service sector jobs were tightly linked to manufacturing in 1984. Altogether, some 27.7 million U.S. jobs were involved in manufacturing, either directly or indirectly (i.e., producing services or material inputs for manufacturing). Jobs associated with manufacturing are generally good ones. Manufacturing wages, overall, are higher than wages in the service sector. Most of the jobs in producer services that are closely tied in with manufacturing are also better than average. To keep these good jobs, as well as good jobs in the manufacturing sector itself, America must compete effectively in the production of goods.

Links Between Manufacturing and Services

It is hardly novel to observe that manufacturing and services are interdependent. When Adam Smith remarked in 1776 that "the labour ... of artificers, manufacturers and merchants naturally does fix and realise itself in some such vendible commodity" he was noting that merchants, although in a service occupation, are among the workers involved in bringing goods to the final purchaser.[83] There are many other sorts of connections as well. Before reaching the merchant who sells it, the vendible com-

83 Adam Smith, The Wealth of Nations, Book IV, chapter IX, cited in J.I. Gershuny and I.D. Miles, The New Services Economy: The Transformation of Employment in Industrial Societies (New York, NY: Praeger, 1983).

modity must first pass through the hands of truckers and warehousers who provide transportation and storage services. Farther upstream, bankers and venture capitalists, insurance companies, lawyers, engineering consultants, temporary help agencies, and computer specialists all contribute to the production of commodities. The service industries, in turn, are important customers of the manufacturing sector. For example, according to one study, 80 percent of the computing, communications, and related information processing equipment sold in the United States in 1982 was purchased by the service sector.[84]

Specialized technical skills are particularly in demand for the manufacture of innovative, high technology products. In microelectronics the links between manufacturing and services are exceptionally close. The highly successful U.S. computer manufacture industry could not have developed without constant interaction between hardware engineers and software designers. Software itself is an excellent example of the marriage of manufacture and services, since it has the character of both a good (it can be stored and shipped) and a service (computer programs are not immutably fixed).

Some kind of services, however, are not very closely tied to the *location* of goods production. In general, the service activities downstream of manufacturing—trucking, warehousing, and wholesale and retail sales of the final product—are not tightly linked with domestic manufacture.[85] Most of these services can just as well take place with goods shipped halfway across the world.[86] On the other hand, upstream services—those that manufacturing firms use as inputs in producing goods—tend to be linked much more closely to the place where the goods are made. These upstream services include such things as process engineering, machinery repair, trucking of goods between related industries, janitorial services, testing and lab work, payroll and accounting services. So long as manufacturing stays home, so will these services and the jobs and national income they generate. If domestic goods are displaced by imported ones, or if U.S.-owned manufacturing operations are moved offshore, then many of the tightly linked upstream services will go with them.

Not all upstream services are so tightly bound. An obvious case is advertising; American agencies, for example, create television ads for Japanese cars. Thanks to telecommunication, some software design has now migrated overseas, e.g., to India, where salaries for engineers are much lower than for their American counterparts. And it is quite possible for foreign banks to lend money to U.S. manufacturing enterprises. By and large, however, upstream services that are inputs to manufacturing stay or go with the manufacturing activity itself, for the simple reason that most services are not very transportable, and are produced near the place where they are consumed.

84 Cited in: James Brian Quinn and Christopher E. Gagnon, "Will services follow manufacturing into decline," Harvard Business Review, November-December 1986, p.96).

85 For a detailed discussion of linkages, not only of services and manufacturing but also of the production of various kinds of goods with each other, see Stephen S. Cohen and John Zysman, Manufacturing Matters: The Myth of the Post-Industrial Economy (New York, NY: Basic Books, Inc., 1987), ch. 2.

86 It should be noted that foreign manufacturers selling in the United States do often set up their own wholesale distribution centers; an example is Japanese multinational investment in the United States, which is heavily weighted to wholesale establishments. Many of the jobs, and a good deal of the income, generated by these establishments go to Americans.

So long as the upstream services are provided by employees of manufacturing firms, they are apportioned in the national accounts to manufacturing output and employment. Often, however, they are provided by outside firms, in which case the national accounts attribute to the service sector activities that are really a part of the fabric of manufacturing. Among the fastest growing sectors in the U.S. economy are those that provide services to companies, rather than consumers. While total employment in all the private service sectors grew at an average rate of 2.6 percent between 1973 and 1986, the number of jobs in business services—which includes advertising, computer software and data processing, temporary help agencies, management services, and research and development laboratories—grew by 7.5 percent a year. Likewise, miscellaneous professional services (including architectural and engineering services and accounting, auditing and bookkeeping) increased at the rate of 5.2 percent per year.

Some of this great expansion in business and professional services in recent years was tied to manufacturing. To get a quantitative idea of the connections between manufacturing and services, an input-output model is helpful. The model can provide estimates of how much the manufacturing sector buys from service industries in the process of making goods and how many jobs are involved, and vice versa. In 1984, private service industries supplied 17 cents of inputs toward each dollar of manufacturing output. Manufacturing in turn contributed 12 cents worth of inputs toward each dollar of output of the private service industries.[87]

The same kind of exchange held for employment. Many of the jobs counted in the service sector are really closely involved in manufacturing. Estimates based on OTA's input-output model indicate the jobs involved in producing services that are inputs to manufacturing numbered about 6.5 million in 1984.[88] In addition, 1.8 million jobs in agriculture, mining, and construction were linked to manufacturing in the same way (table 8). There were 19.4 manufacturing jobs in 1984. Add to that the 6.5 million jobs in service industries and 1.8 million in natural resources producing inputs for manufacturing, for a total of 27.7 million jobs involved, directly or indirectly, in manufacturing. In turn, some 6.5 million manufacturing jobs were devoted to making inputs for the service and natural resource sectors. Workers in these jobs produce goods ranging from tractors to sewer pipes to computers to CAT scanners to paper clips, needed for the conduct of business by enterprises as diverse as farms, sanitary services, banks, hospitals, and insurance offices.[89]

At a finer level, the service industries that are most closely involved with manufacturing are wholesale trade, transportation and warehousing, business services, gas, electric and sanitary utilities, and radio and

87 This exchange is on the basis of gross output of the manufacturing and private service sectors. The figures do not include purchases of capital equipment or structures needed to produce industry output.

88 The OTA model was developed for the assessment Technology and the American Economic Transition (op. cit.). OTA's model is based on the 1980 input-output tables and is updated to 1984 for employment and sectoral demand. It includes capital flows.

89 Estmates of services jobs closely linked to manufacturing, manufacturing jobs to services, and links of both these sectors with natural resources are adapted from the OTA model.

television broadcasting. Each contributes more than 20 percent of its employment to meeting manufacturing demand (table 8). In numbers of jobs, wholesale trade and business services are most prominent, together accounting for about 2.6 million of the 6.5 million jobs involved in service sector inputs to manufacturing in 1984.[90]

The picture emerging from this analysis is interdependence—not primacy of manufacturing as a solid base on which a rather flimsy superstructure of services is erected, nor on the other hand a succession in which services are ousting manufacturing from a place of economic importance. One can also conclude that if manufacturing production and employment is lost, services cannot

Table 8.—Workforce Involved in Manufacturing and Average Full-Time Equivalent Compensation, 1984

	Wage and salary workers involved in manufacturing	Percent of sector employment involved in manufacturing	Average annual full-time equivalent compensation (thousands of dollars)
Agriculture	792	50.4%	$11.3
Mining	443	45.5	37.0
Construction	575	13.3	26.8
Manufacturing	19,396	100.0	28.7
All public and private services	6,492	9.4	24.6
All private services	6,343	11.9	24.4
Wholesale trade	1,501	26.3	27.6
Transportation and warehousing	704	24.2	30.3
Business services	1,276	22.8	24.7
Radio and TV broadcasting	50	21.8	29.6
Electric, gas, water and sanitary services	171	21.4	37.5
Communications, except radio and television	129	11.6	39.7
Automobile repair and services	79	11.6	17.8
Retail, except eating and drinking	1,176	10.3	17.1
Finance and insurance	413	9.0	27.4
Hotels, personal and repair services (exc. auto)	207	8.5	15.7
Eating and drinking places	428	7.9	11.0
Real estate and rental*	72	6.7	21.1
Amusements	46	4.5	19.9
Health, educ. & social serv. and nonprofit org.	89	0.9	20.2
Government	149	0.9	31.1
Total	27,697	29.0%	$27.4

SOURCE: Workers involved in manufacturing data is derived from OTA Input-Output Model (1980 technical coefficients, 1984 estimated demand, 1984 BLS employment, adjusted for capital flows, imports and duties). Compensation data derived from Bureau of Economic Analysis, National Income and Product Accounts, electronic data, mapped to input-output industry classifications.

90 The 1980 input-output tables, on which OTA's model is based, cover only 85 industries, with wholesale and retail trade lumped together. A much finer mesh, covering 537 industries and posting wholesale and retail trade separately, was published for 1977, the benchmark year. For this report, OTA used the 1977 input-output tables to separate wholesale from retail trade, and thus to derive estimates of employment associated with manufacturing for each separately.

simply and directly replace them. A substantial number of service jobs depend directly on the presence of manufacturing. Manufacturing and services are strongly enough linked that they will prosper together or decline together.

Links between suppliers and customers may also be quite close among different manufacturing industries. Of course this is not always the case, since goods can be stored and shipped much more readily than services. For example, U.S. automakers buy components and parts, from engines to windshield wipers, all over the world. At the same time, some major automakers, and other manufacturers as well, are developing stronger bonds with local suppliers. Having suppliers close by enables companies to use just-in-time deliveries, and helps in developing long-term, cooperative relations with the suppliers—both key elements in Japanese manufacturing strategy. In the textile/apparel business, for example, a leading U.S. maker of jeans has completely changed its relations with denim suppliers in the past few years. Instead of driving the hardest possible bargain on price with competing suppliers, the company now buys most of its denim in long-term arrangements from two or three textile manufacturers, gaining the advantages of consistent high quality and just-in-time delivery. In fact, the jeans manufacturer now keeps virtually no inventory and has turned an entire warehouse into sewing space.[91]

Different segments of whole industry complexes may depend on each other to a greater degree than one might suppose, if relations between supplier and manufacturing purchaser were governed only by technical possibilities and not at all by spatial bonds. Cohen and Zysman draw examples from agriculture; they say:[92]

> It is technically possible, but economically improbable to mill sugar cane in a country far from the sugar fields, or to process tomatoes far from the tomato patch, or to dry grapes into raisins or crush them for wine far from the vineyard. It is a forward linkage starting with farming; food processing is downstream in the production chain ... In agriculture, both in theory and in what is too often dismissed as mere real-world examples, tight linkages bind in both directions. There are many activities tightly bound to farming that are backward linkages: crop dusters, animal vets, harvesters, tractor repairers, mortgage appraisers, fertilizer salesmen, blight insurers, agronomists, chemists, truckers, shuckers.

The fiber/textile/apparel complex provides another example. It is conceivable that American textiles could be sold to Hong Kong apparel makers, but the U.S. chemical companies that make fibers and the textile companies that spin and weave the fibers are not counting on it. Both are taking a leading role in strategies to strengthen the U.S. apparel industry, partly by forging stronger links among all segments of the industry, from textiles to apparel to designers and retailers. (Some of the chemical companies

91 OTA interview with Thomas O'Gorman, President, Greenwood Mills.
92 Cohen and Zysman, op. cit.

are also hedging their bets by producing fiber in Southeast Asia, near textile and apparel manufacturing centers.)

An input-output model is not much help in showing the strength of the ties between manufacturing companies. It can show what materials or intermediate goods one industry buys from another, but not whether one depends on the presence of another in the same national economy. For an accurate view of the strength of these spatial bonds, empirical studies of individual manufacturing industries are needed; OTA's full assessment of Technology, Innovation, and U.S. Trade will discuss these kinds of connections in several manufacturing complexes.

Manufacturing and the Quality of Jobs

The kinds of jobs associated with manufacturing are important as well as the number. Pay is better in manufacturing than in the private services overall, and has consistently been so for many years. Moreover, the services jobs most closely connected with manufacturing tend to pay better than services in general.

Total compensation—wages, salaries and benefits—of people employed in manufacturing in 1984 was $28,700; for all workers in the services, it was $22,900, and in the economy overall, $24,300 (see table 8).[93] Jobs in transportation and warehousing, radio and TV broadcasting, and utilities paid as much or more than the manufacturing sector itself, and they are closely linked to it. Over 20 percent of their output goes into manufacturing as inputs, compared to less than 12 percent in private services as a whole. Business, legal, and professional services, a category that includes everything from janitors to corporate tax lawyers, is also closely tied to manufacturing; jobs in this group of industries paid above average for the services, but below manufacturing. Wholesale trade, which has a higher proportion and larger number of jobs (1.4 million) associated with manufacturing than any other service industry, paid nearly as well as manufacturing.

Some service industry groups that do not sell a large share of their output to manufacturing still devote a large number of jobs to manufacturing input. The most important of these is retail trade, which had 1 million jobs associated with manufacturing in 1984, and retail pay is low; Yearly compensation (per full-time worker) averages $17,100. Others with fairly large numbers of jobs linked to manufacturing but low pay are eating and drinking places ($11,000) and hotels and personal services ($15,700). These three low-paying industry groups employed one-quarter of the U.S. service sector workers making inputs for manufacturing in 1984. OTA has calculated the average compensation for jobs in all the service sectors tightly linked to manufacturing at $24,600, compared to $22,900 in the services as a whole, in 1984.[94] The difference in pay between private (non-government) services linked to

93 All compensation figures are given on a full-time worker basis; this eliminates a downward bias in compensation for the service industries, which have a greater share of part-time jobs than manufacturing. Numbers of workers are also given as full-time equivalents. The reason for choosing 1984 as the year for comparing compensation in different sectors is that OTA's input-output analysis showing relations between service and manufacturing jobs was done for that year. Pay in manufacturing jobs and in service jobs associated with manufacturing remained better than in service jobs generally in 1986.

94 This is a weighted average, based on the data in table 8.

manufacturing and all private service industries is even more pronounced—$24,400 versus $21,900.

What is the basis for the longstanding superiority of wages in manufacturing, and in services closely related to manufacturing, over the rest of the economy? Possibly, higher output per employee hour. It has long been considered a truism that productivity is better in manufacturing than in services. This is not entirely true. What does seem to be true is that manufacturing *and* the distribution and producer services with closer than average links to manufacturing have higher than average productivity as well as higher than average pay. The obverse does not hold, however. Finance, insurance, and communications have high productivity and pay well, even though they have only an average, or below average, degree of association with manufacturing.

According to official figures compiled by the Bureau of Labor Statistics (BLS), productivity growth in manufacturing has been higher than in private business as a whole for many years, since 1960 at least (table 9). The discrepancy appears especially remarkable in recent years. From 1979 to 1987, manufacturing productivity rose at an annual rate of 3.4 percent, while for private business as a whole (*including* manufacturing), the yearly growth rate was 1.3 percent. Leaving out agriculture, the growth rate for all private business was only 1.1 percent. These figures seem to mean that manufacturing has carried the whole economy on its back in raising productivity, especially since the 1970s. Recall, however, that the produc-

Table 9.—Productivity in Manufacturing and All Business, 1960–87
(1977 = 100)

Year	All business	Manufacturing
1960	67.3	62.2
1961	69.7	64.0
1962	72.3	66.7
1963	75.2	71.2
1964	78.4	74.6
1965	80.8	76.6
1966	82.9	77.4
1967	85.2	77.4
1968	87.6	79.8
1969	87.7	80.8
1970	88.4	80.8
1971	91.3	85.3
1972	94.0	89.0
1973	95.9	93.4
1974	93.8	90.6
1975	95.7	92.9
1976	98.4	97.1
1977	100.0	100.0
1978	100.8	101.5
1979	99.5	101.4
1980	99.2	101.4
1981	100.6	103.6
1982	100.3	105.9
1983	103.0	112.0
1984	105.6	118.1
1985	107.5	124.2
1986	109.5	128.8
1987	110.5	133.0
Annual average growth rates		
1960-73	2.8	3.2
1973-79	0.6	1.4
1979-87	1.3	3.4

SOURCE: U.S. Department of Labor, Bureau of Labor Statistics, electronic data; *Monthly Labor Review*, various issues, table 44.

tivity figures are based on a constant-dollar series for gross national product that may substantially understate the share of manufacturing in GNP for earlier years—and thus overstate its growth in real output, value added, and productivity.[95]

Another way to compare productivity of manufacturing and various service industries is to look at their respective levels (not growth rates) in one recent year, thus avoiding the problems of using a constant dollar series over time. For this purpose, productivity can be calculated as value added in an industry or sector, divided by the number of hours worked in that industry.[96] On this basis, manufacturing productivity in 1986 was $20.27 an hour, compared to $18.08 for all private services averaged together (see table 10).[97] The average conceals a more interesting story. Business and professional services and the transportation and warehousing industry, all of which devote over 20 percent of their output to manufacturing, are virtually the same as manufacturing in productivity. Public utilities, another industry with close links to manufacturing, has exceptionally high productivity—over $65 of value added per hour. Wholesale trade, with its high proportion and large number of jobs involved with manufacturing, has productivity well above average.

Table 10.—Value-Added per Hour, by Industry, 1986

	Value added per hour	Percent of sector employment involved in manufacturing
Agriculture	$12.68	50.4%
Mining	54.55	45.5
Construction	15.63	13.3
Manufacturing	20.27	100.0
Public and private services	20.21	9.4
All private services	21.86	11.9
Wholesale trade	24.31	26.3
Transportation and warehousing	21.25	24.2
Business services	19.60	22.8
Radio and TV broadcasting	27.49	21.8
Electric, gas, water and sanitary services	65.31	21.4
Communications, except radio and television	45.93	11.6
Automobile repair and services	15.16	11.6
Retail, except eating and drinking	12.62	10.3
Finance and insurance	20.58	9.0
Hotels, personal and repair services (exc. auto)	10.63	8.5
Eating and drinking places	15.41	7.9
Real estate and rental*	161.28	6.7
Amusements	14.51	4.5
Health, educ. & social serv. and nonprofit org.	13.23	0.9
Government	14.57	0.9
Private services excluding real estate	18.08	12.0
Total	$17.77	22.1%

*Value-added includes inputed rent from other sectors of the economy.

SOURCE: Value-added by industry from U.S. Department of Commerce, Bureau of Economic Analysis, National Income and Product Accounts, Gross Product Originating by Sector, electronic data; hours of all persons engaged from U.S. Department of Labor, Bureau of Labor Statistics, Office of Economic Growth, Hours of All Persons, unpublished data; workers involved in manufacturing derived from OTA Input-Output Model (1980 technical coefficients, 1984 derived demand, 1984 BLS employment, adjusted for capital flows, imports and duties).

95 If the constant-dollar value added figures are taken literally, the level of productivity in manufacturing was much lower than in services, and in the economy as a whole, until quite recently. For example, using the BEA series on value added in 1982 dollars, manufacturing output per full-time equivalent employee in manufacturing appears to have been $20,900 in 1960, compared to $25,700 for private services (excluding real estate), and $29,200 for the economy as a whole; for 1986 the comparable figures are $44,000 for manufacturing, $32,800 for private services except real estate, and $38,700 for the whole economy. A series calculated on the basis of constant 1982 dollars shows the level of productivity in manufacturing lower than that of the economy as a whole from 1960 through 1982. In fact, since the figures are still relatively close together, the only way productivity could have grown so much faster in manufacturing than in the rest of the economy for such a long time is to have started at a much lower level.

96 Value added is the difference between the cost of materials, parts, and services that an industry buys to produce an item or service, and the sales revenues the industry collects. The constituents of value added, as usually calculated, are wages, interest, rent, profit, depreciation, and indirect taxes.

97 As noted in table 8, real estate is excluded from this calculation, because in the national income and product accounts, real estate value added includes not only agency fees but also all rents and all imputed rents for owner-occupied dwellings. By this definition, value added in real estate is not really equivalent to value added in other sectors, but is more like gross output, and is inconsistently high.

Highly productive enterprises and good jobs certainly exist in service industries other than those closely linked to manufacturing. The communications industry, including telephone and telecommunication services but excluding radio and TV broadcasting, is near the top in productivity, but has no more than average links with manufacturing. Finance and insurance, a very large sector with employment of 4.9 million in 1986, has productivity equal to that of manufacturing, but is not at all strongly linked. It is also true that none of the service industry groups at the bottom of the heap in productivity—consumer, social, and retail services—is very closely tied to manufacturing (11 percent or less of their output goes into manufacturing).[98] Value added per hour in these industry groups is down in the range of $12 to $13.

All this said, it must be recognized that there is something quite unsatisfactory about comparing productivity from one sector to another. Ideally, productivity would be calculated on the basis of how many man-hours it takes to produce a physical quantity of a good or standard unit of service. The BLS does produce productivity studies of this sort for specific industries. But goods are unlike each other, and services are more different still. To look at productivity in the economy as a whole, or across sectors, the only common unit of measurement is dollars.

It may seem straightforward enough to figure productivity in both goods and services as value added per hour. But what is value added? By definition, it is the sum of wages, interest, rent, profit, depreciation, and indirect business taxes in the sector or industry under consideration. A large proportion of value added, varying by industry but generally about one-half to two-thirds, is wages and salaries plus corporate profits. Thus, if wages and profits are relatively high in an industry, its value added, and therefore its productivity, will show up as high. This may reflect genuinely high productivity—that is, high physical output per hour worked; indeed, the economic foundation for good wages and living standards is high productivity. But within an economy, one sector's wages may be higher than another for reasons other than productivity.

An industry with a lot of market power, i.e., in a near-monopolistic position, can often extract higher prices, and therefore pay higher wages and profits, than one that is more competitive but equally efficient in using labor.[99] Consider steel up until the late 1970s, before international competition and declining demand destroyed the industry's market power. The steel industry paid premium wages, and on the basis of value added, had above average productivity growth in the 1970s. But on the basis of physical output per hour (as calculated by the Bureau of Labor Statistics), steel's productivity growth was below the all manufacturing average for most of the decade.[100] By contrast, agriculture, which has shown strong productivity growth in physical measure-

98 Note, however, that a very large number of retail trade jobs is associated with manufacturing, even though the proportion of linked jobs in this very large sector is only 11 percent.

99 Other factors also affect the ability of near-monopolistic industries to set prices above a competitive level, and thus pay higher wages and profits than they otherwise could. These factors include the degree of elasticity of demand for labor, the elasticity of substitution between labor and capital, and the elasticity of demand for the industries' output.

100 U.S. Congress, Office of Technology Assessment, U.S. Industrial Competitiveness: A Comparison of Steel, Electronics, and Automobiles (Washington, DC: U.S. Government Printing Office, 1981), pp. 56-7.

ments of output (such as bushels of wheat per hour worked), is highly competitive, pays low wages, and has low value added in dollar terms. Also, strong unions can raise wages; and social practices such as paying nurses (female) less than truck drivers (male) can lower pay. Because of these other influences on wages and profits, value added (divided by employee hours) is no more than a rough guide to levels of productivity in different industries.

The fact remains that manufacturing pays better than services, and so do linked services. This at least suggests that manufacturing is able to pay both its employees and its service suppliers relatively well because of superior productivity. This does not mean that other services cannot provide good jobs. Within the designation of "services"are very different kinds of activities; all they have in common is that they do not produce tangible goods, and even that distinction is blurred in some industries, such as software. Some industries in this disparate collection do indeed have low productivity and pay, and employment in these industries (e.g., retail trade) is so large that they pull down the average pay for services in general. Of the service industries that are better paid and more highly productive, several have in common a substantial dependence on advanced technology (e.g., computers in banking, insurance, and telephone communications), or high capital investment per worker (e.g., public utilities), or both.[101] These features are also found in the services most closely linked to manufacturing.

High Technology Industries

Manufacturing industries at the cutting edge of technology, in products or processes, help to buoy the economy, provide new jobs, improve the trade balance, and advance technology outside their own industry as well as within it. Traditionally, whatever industries were at the technological forefront for their time have helped to give the United States a competitive edge. The criteria widely used to define high technology industries are higher than average ratios of technology-oriented workers, and average or higher than average research and development spending.[102] A list of 26 manufacturing industries based on these two criteria includes most of the ones that people intuitively select as high tech (table 11). Among them are computers, electronic equipment and components, communication equipment, precision instruments, specialized engineering products, aerospace, chemicals, and drugs.

Clearly, high tech industries are vital to the nation's future. The development of knowledge-intensive, technologically advanced products and methods of manufacture, from supercomputers to robotics to biotechnology, is indispensable for a better quality of life and rising incomes. The question, however, is whether high tech industries can fill the gaps left by the decline of traditional manufacturing industries, creating high wage jobs and making goods for export to offset imports of standard products made by lower wage workers in

101For an in-depth discussion of different kinds of service industries and a classification based on knowledge-intensiveness, see U.S. Congress, Office of Technology Assessment, International Competition in Services, OTA-ITE-328 (Washington, DC: U.S. Government Printing Office, July 1987).

102This is the definition of Group III high technology industries developed by the Bureau of Labor Statistics; see Richard W. Riche, Daniel E. Hecker, and John U. Burgan, "High Technology Today and Tomorrow: A Small Slice of the Employment Pie,"Monthly Labor Review), November 1983.

Table 11.—U.S. High Technology Manufacturing Industries

Electrical components and accessories
Office computing and accounting machines
Communication equipment
Aircraft and parts
Measuring and controlling instruments
Surgical, medical, and dental instruments
Guided missiles and space vehicles
Drugs
Miscellaneous electrical machinery
Soaps, cleaners and toilet preparations
Industrial organic chemicals
Optical instruments and lenses
Engineering, laboratory, scientific and research instruments
Photographic equipment and supplies
Agricultural chemicals
Miscellaneous chemical products
Industrial inorganic chemicals
Engines and turbines
Petroleum refining
Electrical industrial apparatus
Ordnance and accessories
Paints and allied products
Special industry machinery
Electrical, transmission and distribution equipment
Radio and TV receiving equipment
Plastic materials and synthetics

NOTE: High technology manufacturing industries are defined as those with a proportion of technology-oriented workers (engineers, life and physical scientists, mathematical specialists, engineering and science technicians and computer specialists) equal to or greater than the average for all manufacturing industries, and a ratio of R&D expenditures to sales close to or above the average for all industries.

SOURCE: Richard W. Riche, et al., "High Technology Today and Tomorrow: a Small Slice of the Employment Pie," *Monthly Labor Review*, November 1983.

other countries, as some have suggested.[103] The answer is no. High tech industries do not stand alone, any more than services. Though they are necessary to the generation of jobs, wealth, and exports, they cannot do the job alone.

A great many of the products of high tech industries are intermediate goods used by other industries, both other high tech industries downstream (e.g., computers) and more traditional industries (e.g., autos). There is little consumer demand for semiconductor chips, lasers, or programmable machine tools. The big consumer demand is for goods such as cars, compact disk players, microwave ovens, and washing machines which, increasingly, contain advanced technology products or are made by advanced manufacturing methods. For example, the auto industry is one of the largest users of computer aided design and computer assisted manufacturing equipment (CAD-CAM), robots, and sophisticated machining centers, and is also one of the largest purchasers of semiconductor chips.

Semiconductors illustrate the point that high tech industries depend on other industries to buy their wares. Excluding captive producers (e.g., IBM and AT&T) who make chips mostly for their own use, 85 percent of the 1986 output of the U.S. industry went to non-military industrial customers, who use semiconductors in the process of manufacture or embed them in autos or other consumer goods. About 40 percent of the chipmakers' output went to manufacturers of data processing equipment (including computers), and another 15 percent to producers of communications equipment. Sixteen percent went to industrial machinery and equipment, 7 percent to consumer electronic goods and 8 percent to transportation equipment.[104] Strong demand from the semiconductor-using industries, both traditional and high tech, is fundamental to the strength of the semiconductor industry itself.

Of course, that demand need not all be domestic demand. The United States does

103See, for example, Robert Z. Lawrence, Can America Compete? (Washington, DC: The Brookings Institution, 1984), ch. 4.

104National Science Foundation, The Semiconductor Industry, report of a Federal Interagency Staff Working Group (Washington, DC: National Science Foundation, 1987), p. 6, chart 2, based on information from Dataquest.

have a large share of the world market, but that share is declining, while the Japanese portion is rapidly increasing. Considering only sales of merchant producers, excluding captive consumption in both countries, U.S.-based companies had 40 percent of global semiconductor revenues in 1986, compared to 48 percent for the Japanese.[105] U.S. trade in semiconductors has been in deficit since 1982.

The Japanese semiconductor industry has benefited from strong demand from Japanese manufacturers of consumer products. According to one source, 40 percent of Japan's semiconductors went into consumer products in 1986; the industries included consumer electronics such as television sets, VCRs, compact disc players, and audio equipment. The consumer electronics industry has almost vanished from America (except for Japanese and Korean owned plants that assemble parts imported from the home country); consumer products took only 7 percent of the U.S. semiconductor industry's output in 1986.[106] The demand from consumer products in Japan is not only large; a goodly share of it is reliable, owing to vertical integration that fosters close links between production of semiconductors and end uses. This strong, steady demand provides the wherewithal to pay for successive generations of new equipment. It is one of the factors enabling the Japanese semiconductor industry to develop advanced manufacturing technology that improves yields and cuts manufacturing costs.[107]

Another kind of link is the pool of skills available from traditional manufacturing to further innovation in high tech manufacturing. Invention of new products is often not enough by itself to confer a competitive advantage; the inventor needs manufacturing know-how and other supporting technologies to capitalize on the invention.[108] For example, underneath the creative ferment of new inventions in microelectronics in Silicon Valley is the presence of scores of metalworking job shops with skilled machinists on hand.

Limits on traditional manufacturing skills may limit the possibilities of high tech innovation. The VCR story supplies an example. One reason RCA chose to go with its ill-fated videodisc system (which was unable to record) instead of cassette tape, was that the complex and precise assembly required for the tape player proved to be extraordinarily difficult and expensive; the company thought manufacturing costs would put too high a price tag on the equipment.[109] Although it took years to accomplish, the Japanese producers did eventually achieve

105Ibid, p. 10. According to this source, shipments from U.S. based plants, including captives, were 52 percent of the world total in 1985, but had slipped from 61 percent in the 3 years since 1982.

106Ibid., p. 6, chart 2.

107Michael Borrus, James E. Millstein and John Zysman, "Trade and Development in the Semiconductor Industry: Japanese Challenge and American Response,"in John Zysman and Laura Tyson, eds., American Industry in International Competition (Ithaca, NY: Cornell University Press, 1983).

108David Teece, "Profiting from Technological Innovation,"Research Policy, 1986, vol. 15, no. 6; Nathan Rosenberg, "Technological Interdependence in the American Economy,"Technology and Culture, January 1979, pp. 25-50.

109The projected high cost and difficulties of making cassette tapes, plus severe standardization problems, were other hurdles, probably even more important than the cost of machining and assembling the player. However, the rising cost estimates for the player (up from $450 to $750 as of early 1971) and continuing difficulties in manufacture were central factors in RCA's decision to give up the videocassette recorder and go with the Videodisc. See Margaret B. W. Graham, RCA and the VideoDisc: The Business of Research (Cambridge, England and New York, NY: Cambridge University Press, 1986), especially pp. 128-138 and 148-150.

the necessary precision economically, both for VCRs and for miniaturized products such as Sony's Walkman.

None of this is to underrate the past contributions of high technology industries in America and the importance of their continued development. Several of these industries have expanded much more strongly than manufacturing in general in recent years, and have added jobs even as their productivity soared. For example, employment in computer and semiconductor manufacture combined grew from 520,000 in 1979 to 679,000 near the end of 1987.[110] In the 26 high tech manufacturing industries altogether, employment also rose, but more modestly, from 5.1 million to 5.3 million.

As discussed below, the surpluses of past years in high tech trade have nearly vanished. High technology industries face increasingly stiff competition, both from lower wage but rapidly industrializing Asian countries, and from the higher wage but highly competitive Japanese. World demand for goods related to microelectronics is expected to go on rising strongly, but American manufacturers will have to scramble to keep their share of demand and their output growing. One ingredient in success has to be reliable demand for high tech goods by a strong American manufacturing sector.

110The composition of employment changed in computer manufacture, however; while total employment rose from 320,000 to 406,000 from 1979 to 1987, jobs for blue-collar production workers dropped from 131,000 to 128,000.

The Anatomy of Trade

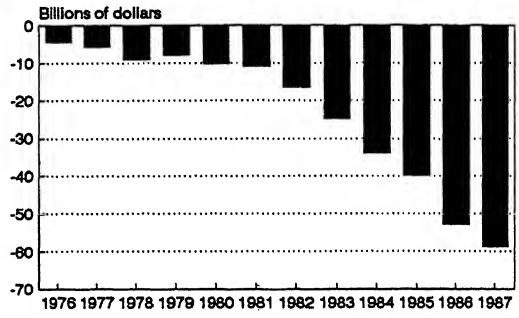
In thinking about different ways in which the United States might turn the trade deficit around, it is useful to consider first what U.S. trade consists of—what we trade, what are the biggest items in the deficit, who are our most important trading partners, and which of them run the biggest surpluses with the United States. These facts about the anatomy of trade as it is now point to the adjustments that will have to be made when U.S. trade comes back into balance.

Products

Manufactured goods account for most of the merchandise trade deficit. Among manufactured goods, by far the most important deficit item is motor vehicles, parts and engines. The deficit in automotive imports alone was over $53 billion in 1987, having risen more than tenfold since 1976 (figure 26); it now amounts to about one-third of the entire deficit in merchandise trade. When U.S. trade deficits fall, it is clear that much of the reduction must be in automotive products—either through importing less or exporting more or both.

Other industrial sectors are also running sizable deficits, and also face pressures for adjustment (table 12). Of course, it is not necessary to reach a balance in every industry; some with surpluses can compensate for others that are in deficit. But the deficits are so great in a few industries that it is hard to see what others could generate high enough surpluses to offset these deficits. As table 12 shows, electronic equipment, including items ranging from semiconductors to television and radio sets, ran a $23 billion deficit in 1987, mitigated only slightly by a $1 billion surplus in computers and automatic data processing equipment. The textile and apparel industry complex hit an all-time high (or low) of $21 billion in deficit. The industry groups with the strongest trade performance were aircraft and other transportation equipment (excluding autos) with a surplus of over $12 billion, and chemicals, with a healthy and rising surplus of nearly $10 billion.

Figure 26
Balance Of Trade in Automotive Products, 1976 - 85



SOURCE: U.S. Department of Commerce, Bureau of Economic Analysis, Business Statistics, 1986, p. 80-81, Foreign Trade of the U.S. - Value of Exports and Imports

It is noteworthy that the worsening trade balances in manufacturing have not spared high technology products.[111] Between 1985

111For international trade, the Department of Commerce defines high technology products as those embodying high levels of research and development expenditures per unit of output; the set of industries producing these goods is similar to the list based on the Bureau of Labor Statistics criteria. See U.S. Department of Commerce, International Trade Administration, United States Trade Performance in 1985 and Outlook (Washington, DC: U.S. Government Printing Office, 1986).

and 1987, for example, the positive trade balance in computers and automatic data processing machinery dropped by $2.8 billion, to about $1 billion (table 12). Overall, the trade balance in high technology products shrank from a surplus of $27 billion in 1980 to a surplus of only $600 million in 1987, having gone through a deficit of $2.6 billion in 1986. The improvement in 1987 was due mostly to rising surpluses in the aircraft and chemical industries.[112]

The record still illustrates something fundamental: high technology industries have come under many of the same pressures affecting other manufacturing industries.

Table 12.—Trade Balance in Selected Manufacturing Industries
(billions of dollars)

Industry	1985	1986	1987
Total manufacturing	-$101.6	-$128.9	$137.7
Durable goods			
Wood and cork manufactures	-$1.4	-$1.4	-$1.6
Furniture and parts	-3.1	-3.9	-4.4
Nonmetallic mineral manufactures	-5.8	-6.7	-6.8
Iron and steel	-9.9	-8.4	-8.5
Nonferrous metals	-5.3	-6.3	-6.0
Misc. metal manufactures*	-3.7	-4.5	-4.9
Industrial machinery	0.1	-5.4	-6.7
Power generating machinery	0.4	-0.5	-0.6
Special industrial machinery	2.2	-0.2	-1.6
Metalworking machinery	-1.6	-1.9	-1.4
Other industrial machinery	-0.9	-2.8	-3.1
Electronic, computing, and office machinery	-15.3	-20.8	-21.6
Office and ADP machinery	3.8	1.4	1.0
Telecomm. and sound reproducing equip.	-14.4	-16.2	-15.6
Semiconductors and other electrical equip.	-4.7	-5.9	-7.0
Motor vehicles	-39.8	-51.6	-53.3
Aircraft and other transport. equipment	11.2	10.8	12.5
Prof., scientific and control inst.	3.4	3.0	3.0
Photo equip., optical goods and timing equip.	-2.4	-2.9	-3.1
Misc. manufacturing**	-10.3	-11.9	-12.8
Military arms, ammo, vehicles	2.7	2.0	2.0
Non-durable goods			
Textiles and apparel	-15.3	-17.6	-20.8
Yarns, fabrics and textile articles	-2.8	-3.5	-3.9
Wearing apparel and accessories	-12.4	-14.1	-16.9
Footwear	-6.0	-6.7	-7.4
Paper, paperboard and manufactures	-3.9	-4.0	-4.4
Chemicals	6.7	7.2	9.6
Organic chemicals and related products	1.3	1.4	1.9
Medicine and Pharmaceuticals	1.6	1.9	1.7
Fertilizers	1.1	1.0	1.4
Synthetic resins, rubbers and plastics	2.1	2.4	3.4
Other chemical materials and products	0.6	0.6	1.1
Tires and tire tubes	-1.7	-1.8	-1.9
Luggage, handbags, and similar articles	-1.5	-1.6	-2.0

* Not specified elsewhere.
** Not specified.
SOURCES: U.S. Department of Commerce, Office of Trade and Investment Analysis, unpublished data.

112Information provided by the U.S. Department of Commerce, Office of Trade and Investment Analysis.

Trade in high technology products is substantial, with imports and exports both reaching just over $80 billion in 1987; high tech imports were almost one fourth of all manufactured imports, and high tech exports were 42 percent of all manufactured exports. While American high tech companies are still quite competitive, it is unlikely that they can regain the kind of dominance they had just a decade ago, relative to producers in Europe, Japan, and a few developing Asian nations. It is therefore unlikely that high tech trade can generate a large enough surplus to offset substantial deficits in traditional sectors.

Countries

The United States trades mostly with other developed nations, although trade with several developing nations has expanded greatly in recent years. The top ten suppliers of U.S. imports in 1987, in descending order, were Japan, Canada, West Germany, Taiwan, Mexico, the United Kingdom, South Korea, Italy, France, and Hong Kong.[113] When the trade deficit is reduced, most of the adjustment will fall on these countries (figure 3). The impact of the adjustment will vary by nation and by region, depending on how important trade with the United States is to our trading partners. It will also depend on how fast the economies of other countries are growing; the more other markets expand, the easier will be the adjustment to reduced sales (or slower growth in sales) to the United States.

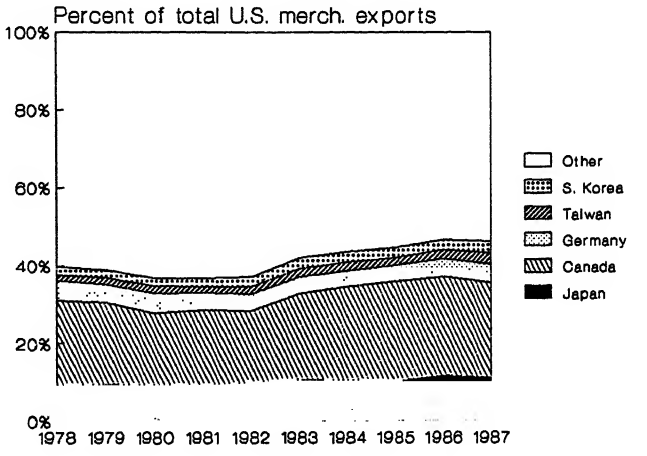
The developed nations that are our largest trading partners will probably have to bear most of the adjustment costs. Six of the top ten suppliers of U.S. imports are developed nations: Japan, Canada, West Germany, the United Kingdom, Italy, and France. Their merchandise trade surpluses with the United States totaled nearly $96 billion—about 60 percent of the U.S. merchandise trade deficit. Figures 27 and 28 show, in percentages, the part played in U.S. trade by our leading trading partners from 1950 to 1986.

Adjustment costs will mean different things to different nations. If American exports are to grow faster than imports, nations that export to the United States can maintain export levels only if worldwide economic growth, including U.S. growth, is substantially greater than it has been in recent years. Faster growth in the American economy—the world's largest—is not likely, since we cannot continue to maintain consumption, investment, and government deficits at current levels indefinitely. Under these circumstances, it will be difficult for foreign producers to maintain their levels of exports to the United States, and many will find that they must replace U.S. customers with others or produce in the United States instead of in the home country.[114] The alternative to these cutbacks would be rapid economic growth rates in the exporting countries, thus enabling them to substitute their own markets as well as others for the U.S. market. Except for Japan these countries have so far shown little evidence of being able or willing to do so.

113U.S. Department of Commerce, International Trade Administration, U.S. Merchandise Trade Position at Midyear 1987, (Washington, D.C.: U.S. Government Printing Office, October 1987).

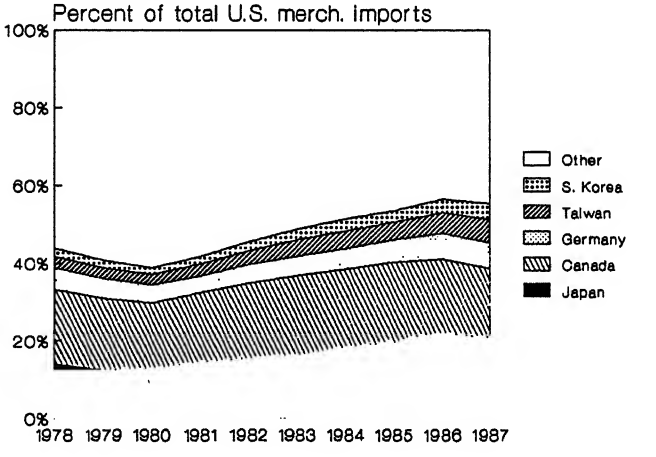
114Until 1985, however, investment by foreign countries in the United States had done nothing to improve the U.S. merchandise trade balance, in fact quite the contrary. This situation may already have begun to change with the falling dollar, but whether or how soon foreign direct investment in American producion replaces imports is uncertain..

Figure 27
Volume of U.S. Exports, 1978-86



SOURCE: U.S. Department of Commerce, Bureau of Economic Analysis, Survey of Current Business, table 3, June 1987 and March 1988.

Figure 28
Volume of U.S. Imports, 1978-86



SOURCE: U.S. Department of Commerce, Bureau of Economic Analysis, Survey of Current Business, table 3, June 1987 and March 1988.

The greatest bilateral merchandise deficit of the United States—$57 billion in 1987, or about 36 percent—is with Japan. Twenty-one percent of U.S. merchandise imports, or $85 billion, were from Japan, and about 11 percent of our exports ($28 billion) are sent there. The deficit with Japan has been one-third to one-half of the U.S. merchandise trade deficit for about the last decade, growing during that time approximately tenfold. In 1986, the leading import by far from Japan was passenger motor vehicles (table 13).[115] This item accounted for $23 billion, or over one-fourth of all imports from Japan, and nearly half the U.S. deficit in motor vehicle trade. Besides motor vehicles, other major imports from Japan include consumer electronics, telecommunications equipment, automatic data processing and office machinery, and electronic components.

Some adjustment has already taken place. For example, even before the fall of the dollar against the yen, beginning in early 1985, there were pressures on and within Japan to change its postwar policies of export-led development.[116] Many nations were exhorting Japan to reduce its trade surplus, and increasing saturation of some export markets was apparent. The Japanese government has announced an official policy of lesser reliance on exports. But shifting to an economy more dependent on growth of domestic consumption is not simple; export growth accounted for almost 40 percent of Japan's economic growth between 1980 and 1985.[117] As exports slackened in 1986, Japanese GNP growth faltered somewhat, rising only 2.4 percent compared to 4 and 5 percent in the earlier 1980s. Capital-investment plans were revised downward.[118] Japanese firms and industries that were particularly hurt by stagnating demand, like the steel industry, began to diversify, entering high technology fields like special chemicals, new materials and biotechnology.[119] At the same time, there were layoffs, especially in the steel industry. Nippon Steel, for ex-

Table 13.—Major U.S. Imports From and Exports to Japan, 1986

	C.i.f. value* (millions of dollars)	Compound annual growth rate 1982-86
Import category		
Passenger motor vehicles	$22.8	21.2%
Phonographs, TV image & sound reproducing equipment	6.0	37.1
Special purpose motor vehicles	5.1	31.6
Telecommunications equipment, nspf**	4.0	23.9
Parts of motor vehicles, nspf**	3.1	50.8
Automatic data processing machines	2.9	64.1
Export category		
Gold (nonmonetary, except ores)	3.3	69.5
Air and spacecraft, etc.	1.8	18.9
Corn or maize, unmilled	0.9	-6.9
Oilseed and oleag. fruit	0.8	-3.7
Wood (rough cut)	0.8	-1.7
Meat (fresh, chilled, frozen)	0.7	9.7
ADP machines	0.7	16.9
Parts for office machines	0.7	13.1
Radioactive and assoc. material	0.6	8.8
Organic chemicals and products	0.6	3.9
Medicinal and pharmaceutical prod.	0.6	6.6
Fish (fresh, chilled, frozen)	0.6	12.3
Measuring and checking instruments	0.6	7.4
Coal and lignite	0.6	-40.8
Petroleum products (refined)	0.4	-2.7

*C.i.f. value of imports includes cost, insurance and freight.
**Not specified.

SOURCE: U.S. Department of Commerce, International Trade Administration, *1986 U.S. Foreign Trade Highlights*, Office of Trade and Investment Analysis, March 1987.

115Detailed figures on trade by product and by country were not yet available for 1987 when this report was written.
116Jon Woronoff, "Japan's Structural Shift from Exports to Domestic Demand," in Japan's Economy and Trade with the United States: Selected Papers, Subcommittee on Economic Goals and Intergovernmental Policy of the Joint Economic Committee, Congress of the United States (Washington, D.C.: U.S. Government Printing Office, December 1985).
117Robert J. Samuelson, "Japan's Case of Malaise," Newsweek, May 4, 1987.
118No Big Deal," The Economist, November 8, 1986.
119Japan: Steelmakers are Vigorously Restructuring," Foreign Broadcast Information Service, 25 February 1987.

ample, announced a temporary layoff of 3,000 of its workers in October 1986.[120]

After this rather rough year, the Japanese economy bounded back in 1987, with a GNP growth rate of 4.2 percent. The revival was fueled by a housing boom, an increase in consumer spending (spurred by a tax cut), and a $46 billion government spending package, including a 20 percent increase in the public works budget. A tax deduction on mortgage loans and a cut in interest rates encouraged the housing boom; housing starts rose over 18 percent in the first half of 1987.[121] The construction activity spilled over into greater demand for steel, which staged a substantial recovery, and a whole range of consumer and household goods.[122] Whether domestic demand will continue to rise at the 1987 rate, compensating for slowing or declining external demand and a shrinking trade surplus, is yet to be seen. The Japanese economy has proven extraordinarily resilient in difficult circumstances before, notably after the oil shock of the early 1970s. And Japanese manufacturers are responding to the high yen by paring profit margins and redoubling efforts to raise productivity.[123] At the same time, Japanese companies are beginning to move some manufacturing operations offshore, in response to the high yen, and these moves are bound to have some dislocating effects on employment and the economy. The adjustment to a higher yen is not yet over.

While the coming changes are not simple and easy for Japan, they could be harder for some of our other trading partners. Among developed nations, Canada and the United Kingdom—our second and fifth largest suppliers of imports, respectively—are in the most difficult positions; both countries run trade surpluses with the United States, but sustain overall trade deficits and relatively shaky economies. Canada, whose economy is heavily dependent on the American market, may face great difficulty—even if the newly established free trade agreement is effective in further liberalizing trade between the two countries.

Between 1976 and 1987, the U.S. merchandise trade deficit with Canada increased from $316 million to $11.9 billion. The 1982 recession and the rise in the value of the dollar were clearly the major factors accounting for the change in trade deficits with Canada. Canada's share of the U.S. merchandise trade deficit rose from its normal 5 or 10 percent to 25 percent in 1982. In absolute terms, the U.S. merchandise trade deficit with Canada increased over 4000 percent, peaking at $15 billion in 1985. The leading import from Canada in 1986 was passenger motor vehicles ($11.9 billion). Canada's top five exports to the U.S. consist of motor vehicles and parts and wood products (table 14).

It could be very costly to Canada to reduce exports to the United States. Nearly four-fifths of Canada's manufactured products are sent here.[124] Finding other markets to

120Japanese Steelmakers, Blasted,"The Economist, January 3, 1987.
121"A Shopping Spree Starts Turning Japan Around,"Business Week, August 17, 1987, p. 50.
122Charles Smith, "Under Its Own Steam,"Far Eastern Economic Review, Feb. 4, 1988.
123See, for example, John Burgess and Fred Hiatt, "Toyota Finds Ways to Hold Down Prices,"The Washington Post, Feb. 16, 1988.
124Marc Levinson, "More Bucks Out of the Maple Leaf?"Dun's Business Month, July 1986, p. 45.

replace lost opportunities will be difficult, particularly if other U.S. trade partners are trying to do the same thing. Past Canadian efforts to diversify exports, and reduce the heavy reliance on the United States, have failed.[125] Moreover, Canada has begun to run current account deficits: about $7 billion in 1987, down from a surplus of $2 billion in 1984.[126] If exports to the United States are curtailed, Canada's trade deficit could increase, putting further downward pressure on an already low Canadian dollar and on Canadian living standards. Canadian unemployment has been higher than that of the United States and many other industrialised countries in the 1980s, though it had declined to 7.8 percent in early 1988. This compares to the current rate of 5.6 percent in the United States, 2.7 percent in Japan, and historical rates in Canada of 3 to 6 percent in the 1960s and early 1970s.[127]

Table 14.—Major U.S. Imports From and Exports to Canada, 1986

	C.i.f. value* (millions of dollars)	Compound annual growth rate 1982-86
Import category		
Passenger motor vehicles	$11.9	19.4%
Parts of motor vehicles, nspf**	4.9	21.3
Paper and paperboard (not cut)	4.5	8.1
Wood (shaped or simply worked)	3.1	16.2
Special purpose motor vehicles	3.1	4.5
Crude petroleum	2.9	7.2
Gas (natural and manufactured)	2.5	-15.1
Gold (nonmonetary, except ores)	2.4	21.5
Export category		
Parts of road vehicles and tractors	6.3	7.6
Passenger motor vehicles	5.9	25.2
General merchandise, low-value	3.2	41.4
Internal combustion & piston engines	1.8	3.0
Trucks & special purpose motors	1.7	41.6
Parts for office and ADP machines	1.2	17.1
Gold (nonmonetary, except ores)	1.1	14.2
Coal and lignite	0.7	-8.2

*C.i.f. value of imports includes cost, insurance and freight.
**Not specified.

SOURCE: U.S. Department of Commerce, International Trade Administration, Office of Trade and Investment Analysis, *1986 U.S. Foreign Trade Highlights*, March 1987.

In another break with the past, the United States is running large deficits with Western European countries. Our merchandise trade with Western Europe fell from a surplus of $20 billion in 1980 to a deficit of $27 billion in 1987. Over one-half of the European deficit—$15.3 billion—was with West Germany; Italy accounted for $5.5 billion, or 20 percent, and the United Kingdom for $3.4 billion. Again, as with Japan and Canada, the largest import item from Western Europe is passenger motor vehicles—$11.7 billion in 1986—with West Germany the major supplier. Motor vehicle imports dwarf the next most important European import, organic chemicals (table 15).

The cost of adjustments will vary among European countries. Unemployment is high in France, the United Kingdom, West Germany and Italy, relative to historical standards. The worst off is France with an unemployment rate of nearly 11 percent in early 1988. The United Kingdom is recovering from a prolonged bout of unemployment at around 12 percent; the rate is currently 9 percent and declining. West Germany's unemployment rate, over 7 percent, is lower, but high by historical standards; the rate throughout most of the 1960s and early 1970s

125Alan M. Rugman, "U.S. Protectionism and Canadian Trade Policy," Journal of World Trade Law, July-August, 1986.
126Organization for Economic Co-Operation and Development, OECD Economic Outlook, (Paris: OECD Publications, May 1986 and June 1987), p. 58.
127U.S. Department of Labor, Bureau of Labor Statistics.

was less than 1 percent. In Italy the current unemployment rate of about 7 percent, is more than double the levels of the 1960s and 1970s. In terms of trade balance, Germany's merchandise trade surplus—exceeding $20 billion in the mid-1980s—puts that country in better shape to handle a diminishing American export market than Italy or the United Kingdom, both of which were in deficit in 1983.[128] These deficits were small: $1.7 billion for Italy, and $0.8 for the United Kingdom. Nonetheless, since both countries ran substantial merchandise trade surpluses with the United States, any loss of U.S. markets would almost certainly mean deeper deficits, and downward pressure on living standards and currency values.

Table 15.—Major U.S. Imports From and Exports to Western Europe, 1986

	C.i.f. value* (millions of dollars)	Compound annual growth rate 1982-86
Import category		
Passenger motor vehicles	$11.7	23.7%
Organic and related chemicals	2.8	12.0
Beverages, alcoholic	2.7	5.1
Air and spacecraft, etc.	2.6	17.4
Crude petroleum	2.3	-23.7
Motor vehicle parts, nspf**	2.2	23.2
Special transactions, nspf**	2.2	7.1
Gold (nonmonetary except ores)	2.2	90.0
Petroleum products	2.1	9.0
Specialized industrial machinery	1.9	24.9
Export category		
Air and spacecraft, etc.	5.1	12.7
Office and ADP machine parts	4.0	14.2
ADP machines	4.0	8.9
Measuring and checking instruments	2.3	2.6
Internal combustion engines	2.2	8.9
Oilseed and oleag. fruit	2.2	-14.5
Coal and lignite	1.8	-10.0

*C.i.f. value of imports includes cost, insurance and freight.
**Not specified.

SOURCE: U.S. Department of Commerce, International Trade Administration, Office of Trade and Investment Analysis, *1986 U.S. Foreign Trade Highlights*, March 1987.

Certain developing nations are important suppliers of imports to the United States and major factors in the U.S. merchandise trade deficit. Those facing the largest adjustment costs are the East Asian newly industrializing countries (NICs)—Taiwan, South Korea, Hong Kong, and Singapore—and two Latin American NICs, Mexico and Brazil. Like the developed nations, different developing countries vary in their abilities to cope with the adjustments.

About one-quarter of the U.S. merchandise trade deficit in 1987—$47.2 billion—was with Asian countries, excluding Japan; the four East Asian NICs accounted for three-quarters of this. The deficit with Taiwan was much the largest: $17.4 billion, compared with $9.4 billion with the Republic of Korea, $5.6 billion with Hong Kong, and $2.1 billion with Singapore. Table 16 lists the most important imports from and exports to the Asian NICs in 1986. If all the separate categories of apparel and footwear are aggregated, this is by far the largest category of imports, amounting to at least $14 billion.[129] Apparel and footwear top the list of imports from three of the Asian NICs (Hong Kong,

[128]U.S. Department of Commerce, International Trade Administration, International Economic Indicators, op. cit.

[129]Trade data are published in ways that make it difficult to sum up large categories of imports, such as apparel, so this estimate is only approximate. Eight of the 35 leading imports from the East Asian NICs in 1986 were apparel and footwear; they added up to $13.8 billion. It is likely that more articles of apparel were imported, but were not among the leading 35. In addition, detailed data on imports and exports by country and by region are published by the International Trade Administration (ITA), U.S. Department of Commerce, and are on a different basis from the more general trade figures published by the Department's Bureau of Economic Analysis (BEA). In the BEA data, both imports and exports are reported on a free alongside ship (f.a.s.) basis, which means the price of the item as it is loaded for shipment. In the ITS data, exports are f.a.s., but imports are reported on a cost, insurance, and freight (c.i.f.) basis, which adds the cost of insurance and freight to the original cost of the item. Thus, in the ITA accounts, imports appear to be greater than in the BEA accounts. Where possible, the BEA figures have been used, because they present imports and exports on the same basis. However, some of the detailed data are available only from ITA.

Table 16.—Major U.S. Imports From and Exports to East Asian NICs, 1986

	C.i.f. value* (millions of dollars)	Compound annual growth rate 1982-86
Import category		
Footwear (new, exc. military)	$3.9	20.5%
Toys and baby carriages, etc.	3.0	13.0
Sweaters and other outerwear	2.9	26.2
Outerwear apparel, (cotton & wool)	2.6	14.4
Office and ADP machine parts	2.2	44.7
Telecommunications equipment, nspf**	2.2	23.8
Electronic components and parts	1.7	8.3
ADP machinery	1.4	128.4
Furniture and parts	1.3	34.3
Television receivers, etc.	1.2	20.2
Undergarments	1.2	12.6
Rubber and plastic articles	1.1	30.4
Export category		
Electronic components and parts	1.5	10.6
Air and spacecraft, etc.	1.2	9.5
Office and ADP machine parts	0.9	23.9
Organic chemicals and products	0.8	14.9
Hides and skins (except fur)	0.6	32.2
Oilseed and oleag. fruit	0.6	7.1
Rubber, plastic and syn. resin	0.5	10.2
ADP machines	0.5	18.1
Measuring and checking instruments	0.5	4.6
Telecommunication equipment	0.4	-4.5
Corn or maize (unmilled)	0.4	-8.5
Pulp and waste paper	0.4	19.1
Wheat (unmilled)	0.4	-4.3

*C.i.f. value of imports includes cost, insurance and freight.
**Not specified.

SOURCE: U.S. Department of Commerce, International Trade Administration, Office of Trade and Investment Analysis, *1986 U.S. Foreign Trade Highlights*, March 1987.

Korea, and Taiwan) and place in the top ten from Singapore. The fastest-growing imports are passenger motor vehicles, which rose from $10 million to $854 million in one year, 1985-86, and automatic data processing machines (including computers and calculators), which increased from $53 million to $1.4 billion in the 4 years 1982-86. Almost all automobile imports from the Asian NICs are from Korea, while automatic data processing machinery exports are from all four nations, with Taiwan accounting for 52 percent, Korea for 26 percent, Singapore for 16 percent, and Hong Kong for 6 percent.

In general, developing nations are less able to cope with a diminishing American market for their exports than developed nations. Even Taiwan, with a healthy and growing trade surplus and massive reserves of foreign exchange, could have problems with adjustment.[130] Like many other developing nations, it is highly dependent on export-led growth, particularly in exports to the United States. America is the market for half of Taiwan's exports, and over half of Taiwan's GNP depends on exports.[131]

South Korea's economy may be more vulnerable, as Korea is only just beginning to reverse chronic trade deficits, and is still trying to pay off a massive international debt.[132] Like other Asian NICs, Korea has pursued a strategy of export-led growth, which is successful as long as exports are able to expand fairly rapidly. In 1987, for example, Korean GNP rose 24 percent, pulled by a 36 percent expansion in exports. Korea was able to run a current account surplus in 1986, for the first time in modern history, mainly

130 Carl Goldstein, "Economic Monitor Taiwan: Exports Hit New Peaks," Far Eastern Economic Review, 9 April 1987, p. 137.
131 Robert G. Sutter, "Taiwan: Recent Developments and Their Implications for the United States," Congressional Research Service Issue Brief IB87092, Updated June 16, 1987; information provided by the Co-ordination Council for North American Affairs.
132 Lawrence A. Veit, "Time of the New Asian Tigers," Challenge, July-August 1987. Korea's international debt totaled $45 billion in 1986—45 percent of Korea's $100 billion GNP.

due to its increasing import penetration of U.S. markets. Lower oil prices, the appreciation of the yen, and falling interest rates helped, but Korea's $9.4 billion trade surplus with the United States in 1987 offset its $5.2 billion deficit with Japan. However, Korea's dependence on exports could backfire when the U.S. merchandise trade deficit shrinks. Exports account for 40 percent of Korean GNP, and 39 percent of Korea's exports go to the United States—up from 30 percent a decade ago.[133] Reducing the U.S. trade deficit might cause political as well as economic trouble in Korea.

The U.S. merchandise trade deficit with Latin America was $12.2 billion in 1987, amounting to only 8 percent of the total. This represented a steep deterioration for the United States, however, with U.S. merchandise trade having descended from a surplus with Latin America of $1.3 billion 1981. Most of the deficit is with just three countries: Mexico ($5.7 billion), Brazil ($4.1 billion), and Venezuela ($2.0 billion) as shown in table 17. In contrast to imports from Asian developing countries, or developed countries, imports from Latin America are tilted heavily towards natural resource commodities: petroleum and agriculture and fishery products account for 40 percent. However, imports of internal combustion piston engines have been growing very rapidly in the 1980s, from $362 million in 1982 to $1.1 billion in 1986, mostly an indicator of the importance of Mexican production. The trade deficit with Latin America peaked in 1984, declining since then as a result of both modest increases in exports and contractions in imports. A part of the drop in value of imports is due to the sharp drop in oil prices in 1986.

Table 17.—Major U.S. Imports From and Exports to Latin America, 1986

	C.i.f. value* (millions of dollars)	Compound annual growth rate 1982–86
Import category		
Crude petroleum	$6.9	-11.9%
Petroleum products	4.8	-12.0
Coffee	3.4	13.1
Fruits and nuts (prepared), nspf**	1.6	9.0
Shellfish (fresh, frozen, salted)	1.2	7.0
Internal combustion engines	1.1	31.1
Footwear (new, exc. military)	1.0	20.4
Electrical distributing equipment	0.8	33.6
Special transactions, nspf**	0.8	0.6
Motor vehicle parts, nspf**	0.8	28.4
Export category		
Road vehicles and tractor parts	1.7	0.8
Organic chemicals and products	1.1	4.1
Air and spacecraft, etc.	0.9	3.1
Telecommunication equipment	1.0	9.2
Civil engineer and contractors	0.9	-13.8
General merchandise, low value	0.9	28.4
Rubber plastic and syn. resins	0.8	3.2
Internal combustion engines	0.8	4.6
Petroleum products (refined)	0.8	-13.9
Office and ADP machine parts	0.7	13.3
Electronic components and parts	0.7	15.0
Electrical appar. (current carrying)	0.6	6.5
Wheat, unmilled	0.5	-19.3
ADP machines	0.5	5.0
Measuring and checking instruments	0.5	-2.7
Electrical machinery	0.5	-0.0
Specialized industrial machinery	0.5	-2.3
Electrical distributing equipment	0.4	27.6
Fertilizers and materials	0.4	6.4
Misc. chemical products	0.4	-1.9
Paper and paperboard	0.4	-4.3
Non-electric parts, nspf**	0.4	0.5

*C.i.f. value of imports includes cost, insurance and freight.
**Not specified.

SOURCE: U.S. Department of Commerce, International Trade Administration, Office of Trade and Investment Analysis, *1986 U.S. Foreign Trade Highlights*, March 1987.

Much of the deterioration in our merchandise trade balance with Latin America in the 1980s has to do with indebtedness. Brazil, the largest Latin American debtor, owed nearly $107 billion to foreign creditors in

133Christopher Madison, "Korea: A New Interest," National Journal, April 5, 1986; information provided by the Korean Embassy

1985; Brazil's foreign debt was equal to 51 percent of its GNP. Mexico owed $97 billion, with debt at over 58 percent of GNP; Venezuela's debt was $32 billion, or 66 percent of GNP. Nations facing heavy international debt burdens have been forced by their major creditors (the International Monetary Fund and U.S., European, and Japanese banks) to devalue their currencies and institute austerity programs—which boost exports and curtail imports—before their creditors would refinance their debts. So far, these countries have made little progress in reducing their debt levels; one result is a conflict between the needs of the United States to curb its merchandise trade surplus and needs of Latin American debtors to run trade surpluses to pay off their debts. Many proposals have been made to deal with the Latin American debt crisis, but whatever the outcome, the difficulties of managing these debts are sure to intensify as U.S. trade deficits fall.

The U.S. trade deficits of the 1980s not only enabled Americans to consume beyond the nation's means—for the time being. They also helped to fuel the economic growth of a number of countries that based their growth on rising exports to the world's largest market. Leaving aside the costs that went along with the benefits of America's buying spree (e.g., job losses of American factory workers), the situation cannot last. As noted earlier, foreign capital will not indefinitely make up a widening difference between what we buy from other nations and what we sell. The burdens of the inevitable adjustment, when it comes, will fall both on American consumers and on foreign exporters. The adjustment might take a number of different forms, some easier than others, but none painless.

International Companies

American companies with affiliates in other countries, and foreign companies with affiliates in the United States, are important players in international trade. Their trade effects (at least through 1985, the last year for which data are available) are not entirely what might be expected. From 1982 to 1985—years of large and growing national trade deficits—all American companies with affiliates abroad showed consistent merchandise trade surpluses of $3 billion to $5 billion with their affiliates (see table 18).[134]

Foreign affiliates of U.S. manufacturing companies accounted for 43 percent of the total $898 billion sales of the foreign affiliates of all American companies in 1985. Trade surpluses of manufacturing parents and their affiliates amounted to $11 billion to $15 billion in 1977 and 1982-85. For the U.S. parent companies overall, trade in petroleum inflated imports, resulting in a small deficit in 1977, and in the 1980s diminishing to some extent the surpluses due to trade between U.S.-based manufacturing companies and their affiliates.

Since World War II, many U.S.-owned companies have engaged in large scale

134The data in table 18 are for U.S. parent companies in the manufacturing industry and foreign affiliates in which they hold a majority interest.

Table 18.—Balance of Merchandise Trade, U.S. Parent Companies and Majority-Owned Foreign Affiliates, 1977 and 1982–85 (billions of U.S. dollars)

	All U.S. companies	U.S. manufacturing companies
1977	$-1.6	$12.3
1982	5.8	14.7
1983	3.6	11.2
1984	3.4	11.7
1985	5.7	14.4

NOTE: Majority-owned foreign affiliates are those in which the U.S. parent company holds a majority ownership.

SOURCES: U.S. Department of Commerce, Bureau of Economic Analysis, *U.S. Direct Investment Abroad, 1977* (Alexandria, VA: National Technical Information Service, April 1981) tables III.T.1 and III.T.4; *U.S. Direct Investment Abroad: 1982 Benchmark Survey* (Washington, DC: U.S. Government Printing Office, December 1985), tables III.P.1 and III.P.4; *U.S. Direct Investment Abroad: Operations of Parent Companies and Their Foreign Affiliates*, 1983–85, available from the Bureau of Economic Analysis, tables 57 and 58.

manufacturing operations overseas, mostly in the developed world. About three-quarters of the sales by foreign manufacturing affiliates of U.S. companies are in developed countries—nearly 50 percent in Europe and another 20 percent in Canada. It is generally accepted that the main reason American companies produce goods in Europe is to sell the goods there; and these operations are associated with trade surpluses for the U.S. parent companies.[135]

Some production by affiliates of U.S. companies in developing and newly industrializing countries is for the same purpose, but another important reason is to reduce costs of producing goods to be sold back in the United States and in other markets. While manufacture by U.S.-affiliated companies in less developed countries is still on a much smaller scale than activities in the industrialized world, there is evidence of change in regional patterns. Manufacturing by and for American companies in Korea, Southeast Asia, and Mexico is growing fast—much faster than production by U.S. affiliates in developed countries. These are the most favored locations for going offshore to lower labor costs. And these operations are generally associated with trade deficits for the U.S. parent company. However, the amounts involved were not yet large enough in 1985 to make much of a dent in the surpluses from operations in Europe and Canada. The large and growing national trade deficits of the 1980s were reduced, not aggravated, by operations of U.S.-based companies abroad.

The opposite has been true of foreign companies and their affiliates in the United States. The deficit arises chiefly from wholesale trade—evidence that the main reason for foreign companies to operate in the United States is to sell here, just as U.S. companies operate in other industrialized countries principally in order to sell there. Merchandise trade between foreign parents and U.S. affiliates showed sizable and growing deficits on the U.S. side, from 1977 to 1985 (table 19). Most of the deficit is due to sales of foreign goods—cars, VCRs, compact disk players—through local wholesale outlets of foreign companies. For example, in 1985, $45 billion of the $54 billion deficit associated with trade between U.S. affiliates and their foreign parents was in wholesale trade—$22 billion in motor vehicles and equipment and another $21 billion in other durable goods.

135Data published by the U.S. Department of Commerce, Bureau of Economic Analysis on U.S. Direct Investment Abroad, Operations of U.S. Parent Companies and Their Foreign Affiliates, show that nearly half of all sales by foreign manufacturing affiliates of U.S. companies are in Europe; that most goods produced by these European affiliates are sold in Europe; and that exports from the U.S. parents to their manufacturing affiliates in Europe are substantially greater than imports.

Table 19.—Balance of Merchandise Trade, Foreign Companies and U.S. Affiliates, 1977–85
(billions of U.S. dollars)

	All U.S. affiliates	U.S. manufacturing affiliates
1977	$ -19.2	$ -3.1
1978	-22.7	-4.2
1979	-23.2	-6.1
1980	-26.0	-5.2
1981	-25.3	-5.1
1982	-26.9	-4.6
1983	-32.2	-6.1
1984	-43.4	-7.7
1985	-54.1	-8.4

NOTE: U.S. affiliates are those in which a single foreign person owns or controls directly or indirectly a 10 percent or greater share.

SOURCES: U.S. Department of Commerce, Bureau of Economic Analysis, *Foreign Direct Investment in the United States, Operations of U.S. Affiliates, 1977–80*, table G-3; *Foreign Direct Investment in the United States, 1980*, table G-3; *Foreign Direct Investment in the United States, Operations of U.S. Affiliates of Foreign Companies*, 1981–85, table G-3, all available from the Bureau of Economic Analysis.

U.S. manufacturing affiliates of foreign parents have also had persistent and growing deficits in merchandise trade, but on a much smaller scale. Considering only trade between the affiliates and their parents, the deficit rose from $3.1 billion in 1977 to $8.4 billion in 1985; if trade with unaffiliated foreigners (on both the import and export sides) is added in, the deficits were smaller, rising from $2.1 billion to $5.6 billion. These deficits are more or less comparable with the surpluses associated with trade between foreign affiliates of U.S. manufacturing companies and their parents. One way that these deficits could arise in the affiliate's country is that the parent company exports parts and materials to its affiliate abroad, where more value is added—but not enough to offset the import of parts and materials. If the item is sold in the affiliate's country, then the sale helps the home country's trade; if it is sold back in the parent country or in a third country it has a negative effect on the home country's trade balance.

The idea that foreign investment in the United States—specifically, investment in manufacturing plants—will reduce merchandise imports very substantially is not necessarily or always true. To the extent items made in the foreign investor's plant replace imported goods, they do reduce imports, and improve the trade deficit. But if they replace goods made by a domestic manufacturer, then they could increase imports and worsen the deficit.

The persistently low dollar may stimulate production of goods in foreign-owned plants in the United States at the expense of imports. There was some evidence by mid-1988 that higher prices, reflecting the high value of the yen, was finally beginning to stem imports of Japanese cars. It would not be surprising if Honda, Toyota, and Mazda were to switch as much production as possible for the U.S. market (and possibly some production for other countries as well) to their American plants. This would help to reduce the trade deficit--and the more U.S. suppliers replace Japanese suppliers, the greater the effect.

Climbing Out: How To Reduce the Trade Deficit

It will be difficult to stop living beyond our means. It will not be painless. But some ways will be more painful than others.[136]

First, the United States could reduce its Federal budget deficit. Some deficit reduction was achieved in 1987: the deficit fell to $150.4 billion, down from $221.2 billion in 1986.[137] The Council on Economic Advisers forecasts further reductions to less than $130 se billion in 1989.[138] To reduce the deficit substantially requires either reduced outlays or higher Federal revenues, and either might also reverse some other trends, including the rising share of consumption in GNP. Higher taxes would also tend to restrict private investment (with harmful repercussions on the performance of manufacturers). Despite some success in cutting the Federal deficit in 1987, the deficit remains very large; further budget cuts will be more difficult to accomplish and raising taxes is unpopular. If there is an economic recession—which some analysts are predicting for 1989—it is likely that the budget deficit will quickly balloon.[139]

Curtailing the growth of consumption and increasing personal saving (which has fallen to record low levels)[140] means living less well, for most Americans. If investment were dampened, efforts to improve competitiveness could be thwarted. Moreover, some foreign governments have been reluctant to spur economic growth and risk inflation, and their disinclination is magnified by America's failure to make more progress in deficit reduction. In short, even reversing the reversible could prove elusive.

Added to this is the fact that there are some things that the United States cannot affect directly, if at all. The prime example is the improved manufacturing and export performance of other nations. The improved performance of many nations results both from improved manufacturing productivity and quality, and from national industrial policies and a world trade regime designed to stimulate development. It would be foolish to expect foreign companies to stop learning how to improve productivity and quality in manufacturing; it is foolish to expect foreign governments to stop promoting their own economic development and exports. We might be able to impose barriers to the continued access of foreign producers to the U.S. market, but we can hardly expect our trading partners to accept such handicaps willingly. Moreover, while there may be cases where such barriers are prudent, a wholesale resort to trade barriers to improve our trade performance could be ruinous, and

136An excellent discussion of some of the choices confronting the United States and its trading partners can be found in Lester C. Thurow and Laura D'Andrea Tyson, "The Economic Black Hole," Foreign Policy, Summer 1987; and in Marris, op. cit.

137Economic Report of the President, Transmitted to the Congress February 1988 (Washington, D.C.: U. S. Government Printing Office, February 1988), p. 337.

138This, of course, assumes that there will be no recession through 1989.

139For example, the Federal budget deficit more than doubled during the 1982-3 recession, increasing from $79 billion in 1981 to $208 billion in 1983. Source, Economic Report of the President, op. cit.

140The personal saving rate, which fluctuated between 6 and 10 percent throughout the 1960s and 1970s (dipping below 6 percent in only 5 quarters since 1962) fell, by 1987, to between 3 and 4 percent. Source: U.S. Department of Commerce, Bureau of Economic Analysis, Business Conditions Digest, January 1988, p. 83.

could undo the progress made in the postwar period toward more open international trading.

The path of relying on further currency adjustments to achieve trade balance could cause considerable pain. It is already apparent, both from research and from the performance of U.S. imports and exports, that the dollar is far from low enough to bring the current account back to historical levels (within a range of $10 billion or so, deficit or surplus). The dollar's value, as of February 1988, had fallen nearly 37 percent from its peak in the second quarter of 1985, on a trade-weighted basis.[141] This has helped to bring U.S. monthly merchandise trade deficits down to $10-14 billion in the first four months of 1988, largely by stimulating exports. It has only recently begun to reduce manufactured imports, although some products—notably, Japanese motor vehicles—have begun to show lagging sales and rising inventorie, a result of price increases induced by the change in dollar-yen values.

Bringing the dollar down further would mean that more imports would move beyond the means of more Americans. By the end of 1987, the unit value index for all U.S. manufactured imports had risen 12 percent from its 1985 level (table 20).[142] Items that are major purchases for most households—notably, motor vehicles—have become much more expensive, rising 30 percent in price above 1985 levels by 1987 (figure 29). While consumers might be expected to switch to domestically produced vehicles, they apparently have not: imported automobiles were expected to account for nearly 30 percent of American sales in 1987, up from 28 percent in 1986.[143] In part, this is because domestic automakers raised prices too, sometimes in response to the rising costs of imported vehicles. Less costly items like VCRs, televisions, and CDs have also become more expensive, although many of these items come from countries like Taiwan and Korea, whose currencies have not risen very much relative to the dollar (although there is a great deal of pressure on these nations to raise their currency values). The prices of imported office machines and automatic data processing equipment increased 45 percent between the first quarter of 1985 and the last quarter of 1987, and imported telecommunications equipment prices rose 8 percent. Imported sound and image tape recorders and players (including VCRs) went up by 16 percent. Interestingly, the prices of imported television receivers dropped 2.5 percent.[144] This shows the effects of substituting imports from Korea, and from other nations whose currencies have risen less against the dollar, for more expensive exports from Japan.

Consumers are not the only ones to suffer as import prices rise. Imported capital goods have become more expensive too, and many producers are finding it more difficult to afford imported machinery and equipment as a result. Imported capital goods cost almost 9 percent more in 1987 than in 1985. The price of imported textile industry machinery

141International Monetary Fund, International Financial Statistics, April 1988, country pages.

142Unit Value Index numbers are from the Department of Commerce, Office of Trade and Investment Analysis.

143U.S. Department of Commerce, 1988 U.S. Industrial Outlook, (Washington, D.C.: U.S. Government Printing Office, January 1988), p. 38-3.

144Import price data for office and ADP machines, telecommunications equipment, televisions, and sound and image tape recorders and players are from the Bureau of Labor Statistics,

Table 20.—Average Prices, Imports to the United States (1977 = 100)

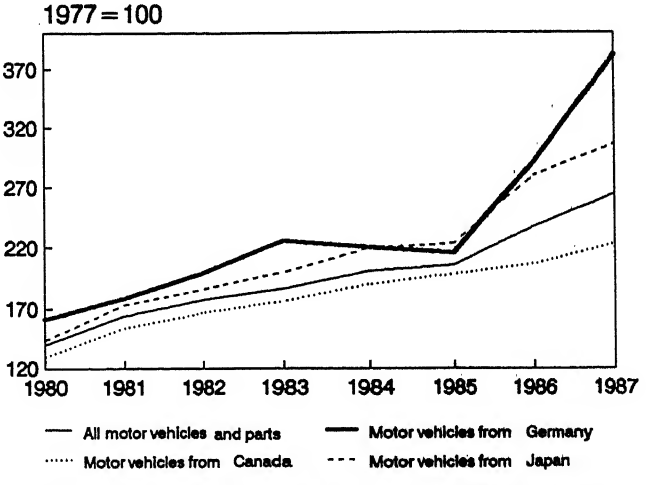
	1980	1981	1982	1983	1984	1985	1986	1987
All commodities	161.4	170.3	167.5	160.6	163.5	159.4	154.0	164.6
Manufactured goods	140.6	145.5	148.1	143.6	148.0	146.1	153.0	163.2
Consumer goods, non-food, non-auto	131.1	137.1	141.0	133.5	134.8	128.9	130.1	133.9
Autos	139.8	163.5	177.2	186.5	200.3	205.0	236.9	264.2
Autos from West Germany	160.8	178.2	198.9	225.6	220.2	215.1	290.8	381.4
Autos from Canada	129.3	153.3	166.8	176.0	189.8	197.5	205.9	222.6
Autos from Japan	143.6	172.6	185.4	199.2	220.1	223.2	279.5	306.3
Nondurable goods	141.0	142.8	156.1	120.5	115.5	104.5	103.9	99.2
Woven cotton fabrics	126.4	143.5	147.9	144.4	156.0	144.4	140.2	163.0
Capital goods	126.7	123.1	126.4	122.0	128.6	131.0	136.2	142.4
Industrial supplies and materials	192.1	206.6	195.3	180.6	178.1	167.2	129.5	143.1
Textile machinery except weaving	215.5	218.2	204.9	229.2	246.1	247.4	283.6	356.2

NOTE: Average prices for imported items are expressed as unit value indexes.
SOURCE: United States Department of Commerce, Bureau of the Census, unpublished data.

rose 44 percent over the same period.[145] Because most textile industry machinery is imported, textile makers are, in most cases, unable to switch to cheaper domestically-made machines. This could handicap the efforts of the industry to improve product quality, raise productivity, and compete with less expensive, imported textiles.

Another danger of relying only on further devaluation of the dollar to reduce the trade deficit is the risk of a severe recession. If we take no other action to reduce imports, increase world demand, reduce the budget deficit, and raise exports, foreign governments and private investors will force a solution by curtailing investment in American assets and securities. If that happens, we face a period of rising real interest rates as consumers, investors and the U.S. treasury compete for an increasingly limited supply of capital. Exchange rate markets would also be in turmoil, as the dollar, no longer supported by foreign demands for dollars, declines further, and sharply. These developments could force the U.S. economy into a recession, which would almost certainly engulf other nations whose welfare depends substantially on the American economy. According to

Figure 29
Average Price, Imported Motor Vehicles and Parts



NOTE: Average Prices for imported commodities are reported as Unit Value Indices.

SOURCE: U.S. Department of Commerce, Bureau of the Census, various years, unpublished data.

145Source: Department of Commerce, unpublished data on Unit Value Indexes for Imports.

some analysts, such a recession would include increasing inflation as well as rising interest rates—both of which would depress consumption (and thereby, standards of living). Rising interest rates also choke off investment, which would hamper the ability of American firms to improve their competitiveness. In short, a recession generated by a cutoff in foreign capital inflows would be a setback to our efforts to balance trade in manufacturing by means other than protection from imports.

Finally, relying on currency adjustments for further improvement in trade performance is undependable at best. Many businesses that are beginning to boom as export orders rise are reluctant to add capacity or make significant long-term investments in plant and equipment solely on the strength of a currency-induced upturn, since currency adjustments are beyond the direct control of manufacturers. According to one article, manufacturers still are unconvinced of the durability of the dollar's drop, and even those that are reaching production limits are reluctant to expand capacity.[146] Some companies are even passing up export business, preferring to serve domestic customers instead as they push production closer to capacity.[147] Many manufacturers see the dollar's fall as a windfall, offsetting its disastrous rise—much as farmers welcome rain after a drought. Long-term improvement in our trade picture cannot be based on such windfalls. Sustained improvement must be based on something more reliable: improved competitiveness.

In terms of the macroeconomic adjustments, the least painful course would be steady and substantial progress by the United States in reducing government deficits, reducing the growth of consumption and increasing savings; more expansionary policies and stimulatation of demand in major developed nations; efforts to find ways for developing nations to reduce their debt burdens and begin to open their markets.

This is a tall order. At best, such changes will take years, and an extraordinary degree of cooperation between nations. But progress must be made if we are to restore some degree of predictability and stability to international markets.

Besides these changes, prompt and comprehensive efforts to improve U.S. manufacturing performance are needed. Technology—broadly defined—has been a source of strength. Promoting development, acquisition and diffusion of new product and process technologies will help to improve competitiveness. Other actions that government might undertake include improving education and training workers and managers in new skills, helping firms to export, encouraging investment in productivity-enhancing machinery and qualified people, and providing information about effective ways of organizing production and developing new markets. The government could also evaluate how other policies encourage longer term investments in product and process improvement. This is not a catalogue of government policy options to

146Alan Murray, "Aided by Weak Dollar, Factory Output Leads Economy Once Again," Wall Street Journal, Jan. 26, 1988.
147Ibid.

foster improved manufacturing performance; it is only a short list drawn from past work.[148]

The trade patterns of the 1980s are a significant departure from any past experience, and the enormous current account deficits of the United States have changed economic relationships throughout the world. While some remedies will make more of a difference than others, solutions that aim at only one area—such as promoting competitiveness or reducing federal spending or further devaluing the dollar or opening foreign markets—cannot achieve more than limited success. We must make progress in many areas to overcome the trade deficit while minimizing the impact on standards of living. Whatever solutions we adopt, we are in uncharted waters: we have never had such problems to solve before.

148See, for example, U.S. Congress, Office of Technology Assessment, International Competitiveness in Electronics, OTA-ISC-200, (Washington, D.C.: U.S. GPO, November 1983); U.S. Congress, Office of Technology Assessment, International Competition in Services, OTA-ITE-328 (Washington, D.C.: USGPO, July 1987), U.S. Congress, Office of Technology Assessment, Technology and Structural Unemployment, OTA-ITE-250 (Washington, D.C.: USGPO, February, 1986); The President's Council on Industrial Competitiveness, Global Competition: The New Reality, op. cit.; and Thurow and Tyson, op. cit.

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